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XI.—1925—1926.

REPORT
ON THE
OUTBREAK OF PLAGUE
IN
KUMASI, ASHANTI.

BY
P. S. SELWYN-CLARKE, M.C., M.D., B.S., M.A.C.S., L.R.C.P., D.P.H., D.T.M. & H.
MEDICAL OFFICER OF HEALTH, KUMASI

Ordered by His Excellency the Governor to be Printed.



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SANITARY DEPARTMENT,
KUMASI.

4th October, 1924.

SIR,

I have the honour to submit the accompanying four copies of my report on the recent outbreak of plague in Kumasi.

The following salient features of the outbreak are of interest.

The first case of plague was discovered on the 17th of June some five days after I assumed duties of Medical Officer of Health, Kumasi.

From that date until the 17th of September a total of 140 cases of plague occurred with 121 deaths or a mortality of 86.4%

Since the 17th of September to date (October 4th) there have been two additional fatal cases and a third case which although not diagnosed bacteriologically—and so not reported—has the clinical appearance of a case of bubonic plague. This case came from the same small village as the two fatal cases but there is every chance now of the patient surviving.

During the same period (17th June—17th September) 1,434 contacts were kept under surveillance and 39 or 2.7% of these contracted plague.

In the same period anti-plague vaccinations to the number of 103,374 were carried out. Between 5 and 10% of these were probably re-vaccinations.

Further, 560 compound houses comprising 6,815 rooms were disinfected with sulphur di oxide gas and a further 800,000 cubic feet were disinfected with hydrocyanic acid gas. Compound houses to the number of 129 comprising 802 rooms were demolished and over 3,000 windows (apart from other alterations) were made in the Zongo and Zongo Extension to mention but one district of the town.

Rats caught during the period numbered 4,939 of which 266 or 5.38% were found to be infected with an organism resembling *B. pestis*.

Some 15,000 intending passengers by train were medically examined at the railway station and, where necessary, vaccinated before being allowed to board trains to Accra and Sekondi and intermediate outstations.

On one day (15th September) as many as 7,194 persons had their passes examined at the police barriers established at eleven points round the outskirts of the town before they were able to leave Kumasi.

The number of passes so examined during the quarantine period must have been nearly half a million.

Sanitary summonses for June, July and August numbered 1,938 as compared with 412 in the three months March, April and May before the writer assumed duties here. (The additional staff sent up was utilised for the most part on work in connection with disinfection, registration of thumb prints, etc.)

A casual glance at the above figures, which represent but a portion of the work done during the past four months, will help to demonstrate the fact that my staff have been working hard from early morning to late at night and I have the honour to request that you will bring the following names of officers who have done particularly fine work to the right quarter.

(1) Dr. W. M. Howells whose services were very kindly lent to me by Dr. M. E. O'Dea, the Honourable Director of Medical and Sanitary Services, from the 8th of August until the present date. This officer has done exceptionally good work in connection with Kumasi Old Town and has relieved me of a great deal of anxiety with regard to the sanitation of this portion of the township. I could not hope to work with a more hardworking and conscientious officer.

(2) Dr. P. A. T. Sneath. This officer bore the brunt of anti-plague vaccination work from the time he came to Kumasi on the 28th of June to the day he left to proceed on leave on the 30th of July. In the early days, before time had permitted of a complete and smooth—running organisation being established at the Central Vaccination Station, this officer cheerfully worked all day until, on several occasions, after dusk, and he was responsible for carrying out several thousand vaccinations and for issuing many thousand road permits.

(3) Mr. H. T. Lucas, Senior Superintending Sanitary Inspector. This officer served as a fine example to the sanitary inspectors under him and rendered the writer valuable and willing services during the earlier part of the outbreak before he was transferred to Accra on the 30th of July.

(4) Mr. W. R. Lawless, Superintending Sanitary Inspector. Although new to the Colony and accustomed to very different conditions at Singapore, this officer rapidly adjusted himself to local conditions and proved a most loyal and conscientious worker.

(5) Mr. F. W. Abbott, Laboratory Assistant. This officer carried out nearly 5,000 examinations on rats between the 23rd of June and the 17th September, besides examining a large number of dogs, cats, guinea pigs, etc.

In addition he examined large numbers of smears. Apart from the purely laboratory work, however, Mr. Abbott was always more than ready to help in whatever way he could even when it involved no little discomfort to himself. The writer records with pleasure his appreciation of the way in which Mr. Abbott carried out his work, which must have become very monotonous and tedious as the epidemic progressed, and of the way in which he rose to emergencies and assisted in work that had no connection whatever with laboratory work.

(6) Mr. J. S. Abbey, 2nd Division Sanitary Inspector. This officer was indefatigable, working from early morning until late at night—sometimes until midnight on important disinfections,—and in all weathers. He carried out the work of a 1st Division Sanitary Inspector and on several occasions it was through his acumen and hard work that cases of plague were traced enabling appropriate action to be taken. Mr. Abbey went down with a bad attack of fever towards the end of the outbreak, probably due to his exposure and loss of sleep, but he would have stayed on duty if the writer had not taken him to the Medical Officer of the Native Hospital where he was immediately admitted.

(7) Mr. Alazuma, Assistant Disinfector Mechanic. This officer was almost as indefatigable as Mr. Abbey and on many occasions willingly carried on disinfections of infected premises and neighbouring houses long after night fall.

(8) Other officers who did good work include :—

Dr. E. S. Mack whose services were very kindly put at the writer's disposal from the 28th of July to the 20th of September by Dr. M. E. O'Dea, the Honourable Director of Medical and Sanitary Services, who had to close a station in order to do so. Dr. Mack carried on the work at the Central Vaccination Station after the departure of Dr. P. A. T. Sneath and carried out many thousand vaccinations. He also carried out useful investigations of alleged outbreaks of sickness in neighbouring towns when the supplies of vaccine were low or exhausted.

Mr. A. E. Bentil, 1st Division Sanitary Inspector. This officer who came to Kumasi on the 8th of August rendered useful assistance in taking charge of a disinfection gang.

Mr. F. R. C. Nartey, 2nd Division Sanitary Inspector. Much good work was carried out by this officer who came to Kumasi on 14th of July to assist in the provision of a number of temporary modified Salga-type latrines, whose construction he ably carried out in parts of Kumasi where no provision of latrines had been made previously.

Mr. Ebenezer Okyne, Temporary Clerk. This officer, though on the small salary of a temporary official, cheerfully worked at the writer's office on Saturdays and Sundays and often until 7 p.m. in order to get the routine work done and daily reports typed so that you might have the latest information regarding the progress of the outbreak.

The late Mr. E. Beechman. This officer volunteered on the 29th of June as a nurse in the Contagious Diseases Hospital. He was the sole nurse obtainable at the time and he worked hard night and day. He contracted pneumonic plague from a patient and, I regret to say, died on the 13th of July.

In conclusion, I should be grateful if you would bring to the notice of Dr. M. E. O'Dea, the Honourable Director of Medical and Sanitary Services, my gratitude to him for his ready, help and encouragement during the epidemic and for his kindness in going to the extent of closing other stations in order to release medical officers to assist me in coping with the situation.

I have the honour to be,

Sir,

Your obedient Servant,

P. S. SELWYN-CLARKE M.D.,
Medical Officer of Health.

THE DEPUTY DIRECTOR OF SANITARY SERVICES,
VICTORIABORG—ACCRA.

REPORT ON THE OUTBREAK OF PLAGUE IN KUMASI,
ASHANTI, GOLD COAST COLONY.

BY

P. S. SELWYN-CLARKE,
M.C., M.D., B.S., M.R.C.S., L.R.C.P., D.P.H., D.T.M. & H.
MEDICAL OFFICER OF HEALTH, KUMASI.

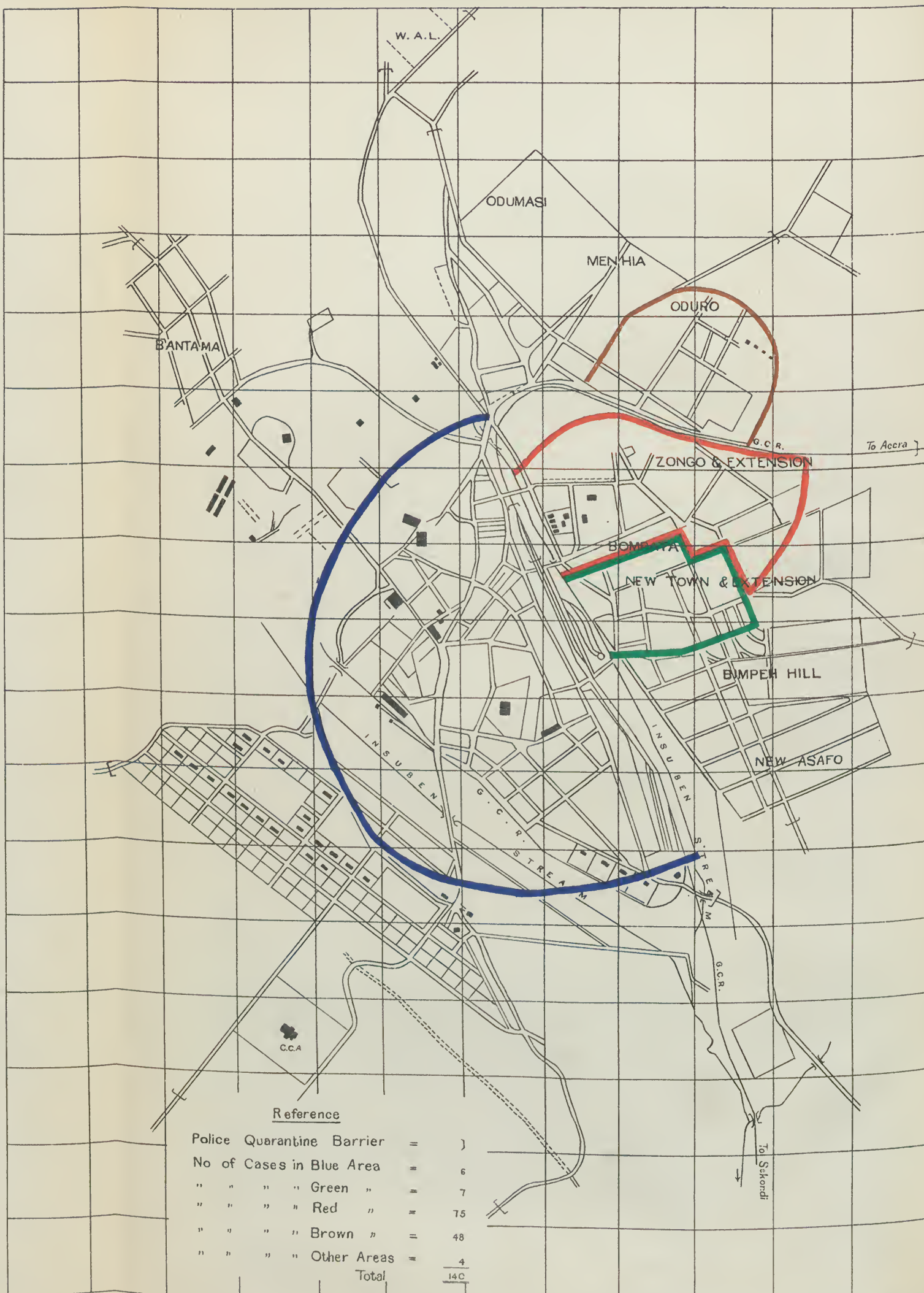
“ Familiarity with health has in certain quarters bred contempt of health measures ;
or, to put it another way, unfamiliarity with epidemics has led to forgetfulness of how such
immunity was purchased, and how alone it can be maintained.”

ANDREW BALFOUR,

C.B., C.M.G., M.D., B.Sc., D.P.H., F.R.C.P., Ed.

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KUMASI.



SCALE = $\frac{1}{18,750}$ Ft.

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PLAGUE IN KUMASI.

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A type of insanitary hovel in which three cases of Plague occurred.



Another type of insanitary house in which several cases of Plague occurred. The heap of swish and sticks in the foreground resulted from the demolition of a number of hovels covering the Compound itself.

(I) HISTORICAL FACTORS.

In the absence of the necessary books of reference it is only possible to give a brief outline of the history of plague in the Gold Coast.

Towards the end of 1891 a serious outbreak of sickness occurred in the Colony.

In Accra where careful investigations were made, this disease appeared to be characterised by broncho-pneumonia supervening after two days of malaise and one day of fever with fatal issue on the afternoon or evening of the fourth day.

In his annual report for 1919, Dr. T. E. Rice, C.M.G., referring to this epidemic wrote as follows :—

“ It must be remembered that the outbreak referred to occurred before the discovery of the plague bacillus had made the detection of that disease easy and certain. A disease described as always ending fatally in double pneumonia on the fourth day is very suggestive of plague.”

In January, 1908, cases of plague were recognised for the first time in the Colony when an epidemic broke out in Accra.

As the result of the investigations that were made during that year there would appear to be no doubt whatsoever that the disease was actually prevalent in Accra in November, 1907, and possibly even earlier. No evidence was forthcoming as to when or by what means infection was originally introduced into the Colony.

Excluding the possibility of the fatal outbreak of infective broncho-pneumonia of 1891 having been of plague origin it would appear to be somewhat probable that infection was introduced into the Colony in the latter half of 1907.

Sir William Simpson (then Professor Simpson) recorded the following opinion in his report to the Right Honourable the Secretary of State. “ There is evidence to show that the infection of plague was present in Accra about a month or two before it assumed epidemic proportions. In the month of November many rats died and it was at this time that several cases of swellings set down as guinea worm occurred in the groin.

“ This is a very unusual situation for guinea worm and as several of the cases proved fatal they would rather indicate plague of bubonic type. There also occurred in this month of November in James Town six deaths in one family the members of which dwelt in several huts but within the same compound.

“ Later other families were attacked, and in December quite a number of people died of the new disease which was characterised by fever, swelling in the groin and armpit, and rapid death.”

From January, 1908, until the 10th of April of the same year 258 out of the 302 cases that were discovered in the Colony proved fatal.

In Accra itself 127 deaths were recorded among 168 cases while 25 fatal cases were reported from villages in Accra district and a further 106 fatal cases from villages and townships in the Central Province.

Most of the cases in Accra were of the bubonic type whereas the majority met with in other areas were of the pneumonic type.

In a second outbreak in June, 1908, 23 deaths from plague occurred in Accra from the 3rd to the 26th of the month while an additional 12 fatal cases were reported from villages situated within 20 miles radius. Six fatal cases all of the pneumonic type were encountered in a third outbreak in Accra between the 28th of July and the 17th of August, while an isolated death from pneumonic plague took place on the 13th of October of the same year.

It will be seen from the foregoing that a total of 344 cases of plague were discovered in the Colony between the 5th of January and the 13th of October, 1908, of which 310 or 90.1% proved fatal.

The information available with regard to the subsequent history of plague in the Gold Coast is somewhat scanty.

It is interesting to note that the presence of plague was suspected in 1916.

In the Annual Medical and Sanitary Report for that year Dr. D. Alexander, C.M.G., then Senior Sanitary Officer, wrote as follows :—

“ In April, both at Accra and Kumasi, there were an unusual number of deaths from pneumonia. Three sudden deaths at Kumasi gave rise to suspicion that the deaths might have been due to pneumonic plague. Postmortem examinations were made, and microscopical examination of the smears shewed a capsulated Gram-staining diplococcus.”

It would appear, however, that the Colony was free from the disease until 1917, when six cases were reported.

In the Annual Medical and Sanitary Report for 1917, Dr. Alexander made the following statement :—

“ On the 5th of March (1917) the existence of plague in the Accra district was definitely established. It made its appearance first at Ofako and later on in the same month at Temma, and one non-imported case occurred in Accra.

“ The course of the outbreak and the method in which it was dealt with have formed the subject of special reports and do not require any further reference here. Six cases were seen with six deaths, but it is estimated that there were at least 39 deaths.“.....” It was not possible to trace the origin of outbreak of plague in 1908 or to have proved that it had been introduced from without. The same applies to the present outbreak and it would appear, therefore, correct to assume that plague is another of the endemic diseases that we have to be on the outlook for on the Gold Coast.”

The writer finds it difficult on the evidence adduced to accept the dictum made in the latter half of the last sentence by his distinguished colleague.

Nine cases of pneumonic plague were reported as occurring in Axim in December, 1917, and there was a recurrence in July, 1918, in the same port.

The following interesting note occurs in the report of the Acting Pathologist (Dr. A Ingram) forming an appendix to the Annual Medical and Sanitary Report for 1918 :—

“ Smears were made from the lungs and other viscera in eleven cases where death was ascribed to influenza.

“ Pneumococci were found in the smears from the lungs in every case, Gram-positive cocci and streptococci occurred in three cases, a small Gram-negative coccobacillus in two and a larger Gram negative bacillus exhibiting rounded ends and bipolar staining in a single case.”

In July, 1919, a single case of pneumonic plague occurred in a krooboy resident in Accra.

The source of infection remained undiscovered.

From 1919 to March of the present year (1924), an interval of nearly five years, the Gold Coast appears to have been free from plague. As regards neighbouring countries it is interesting to note that a serious outbreak of plague occurred in the French Ivory Coast in 1921, that an outbreak occurred in the North Bank Province of the Gambia in 1922—infection having been introduced, it is alleged, from the French Senegal which was infected during the whole of 1922—and that cases were reported from the Canary Islands in 1923 and early in 1924. Plague re-appeared on the Gold Coast in March of the present year, ninety-six cases being reported from Sekondi between the 13th of March and the 27th of April.

This number does not comprise the total number of cases in Sekondi and district since minor outbreaks occurred subsequently.

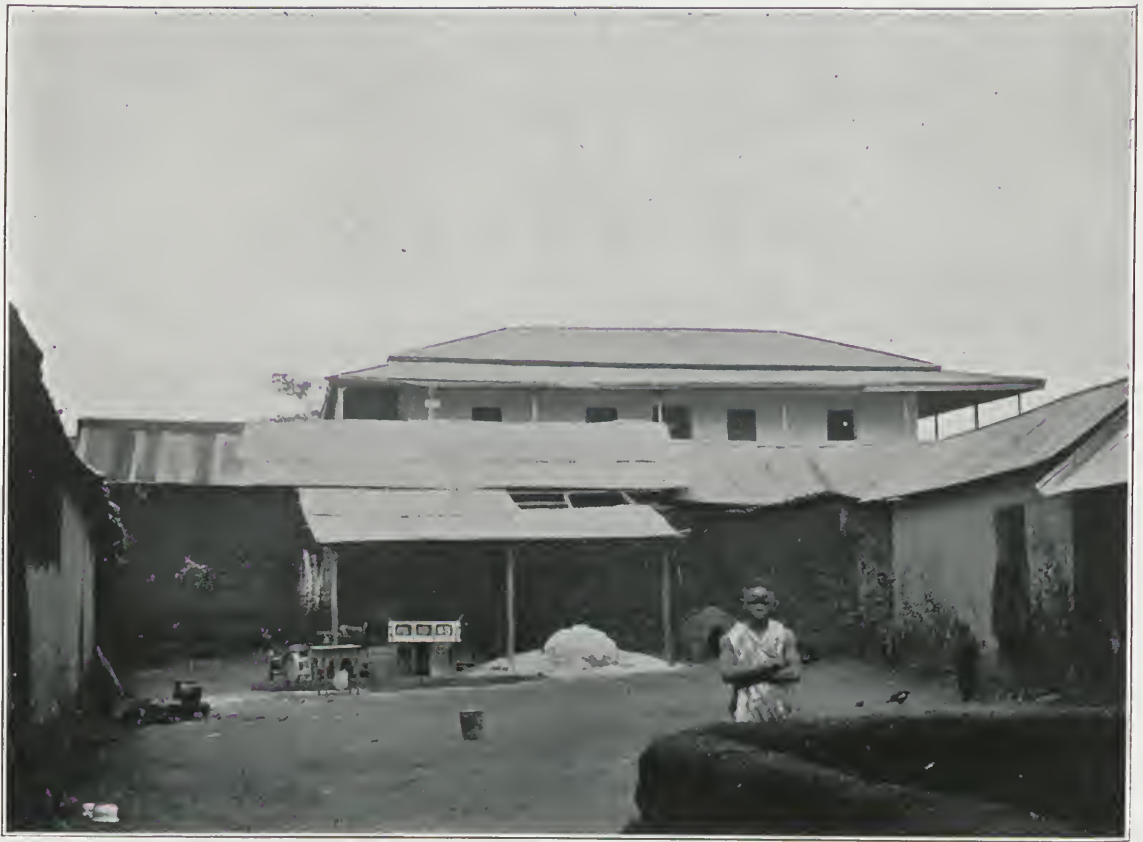
From the records available it would appear that plague was unknown in Kumasi and district until the epidemic which forms the subject of this report occurred.

(II) GEOGRAPHICAL FACTORS.

Kumasi is the capital town of Ashanti, a large tract of fertile territory lying between the Colony proper on the south, the Northern Territories on the north, the French Ivory Coast on the west and the Mandated Territory of Togoland on the east.

The town forms the present terminus of the two main lines of the Colony, being within about 12 hours railway journey of the ports of Accra and Sekondi.

It is also the most important centre of trade in Ashanti and from it good roads radiate to all points of the compass. Along these roads passes to and fro a continuous stream of traffic from the coast and towns in the Colony to all parts of Ashanti and to the Northern Territories.



The compound of the Chief of Bantama showing the way in which the yards have been allowed to be built over so that congested areas are formed.

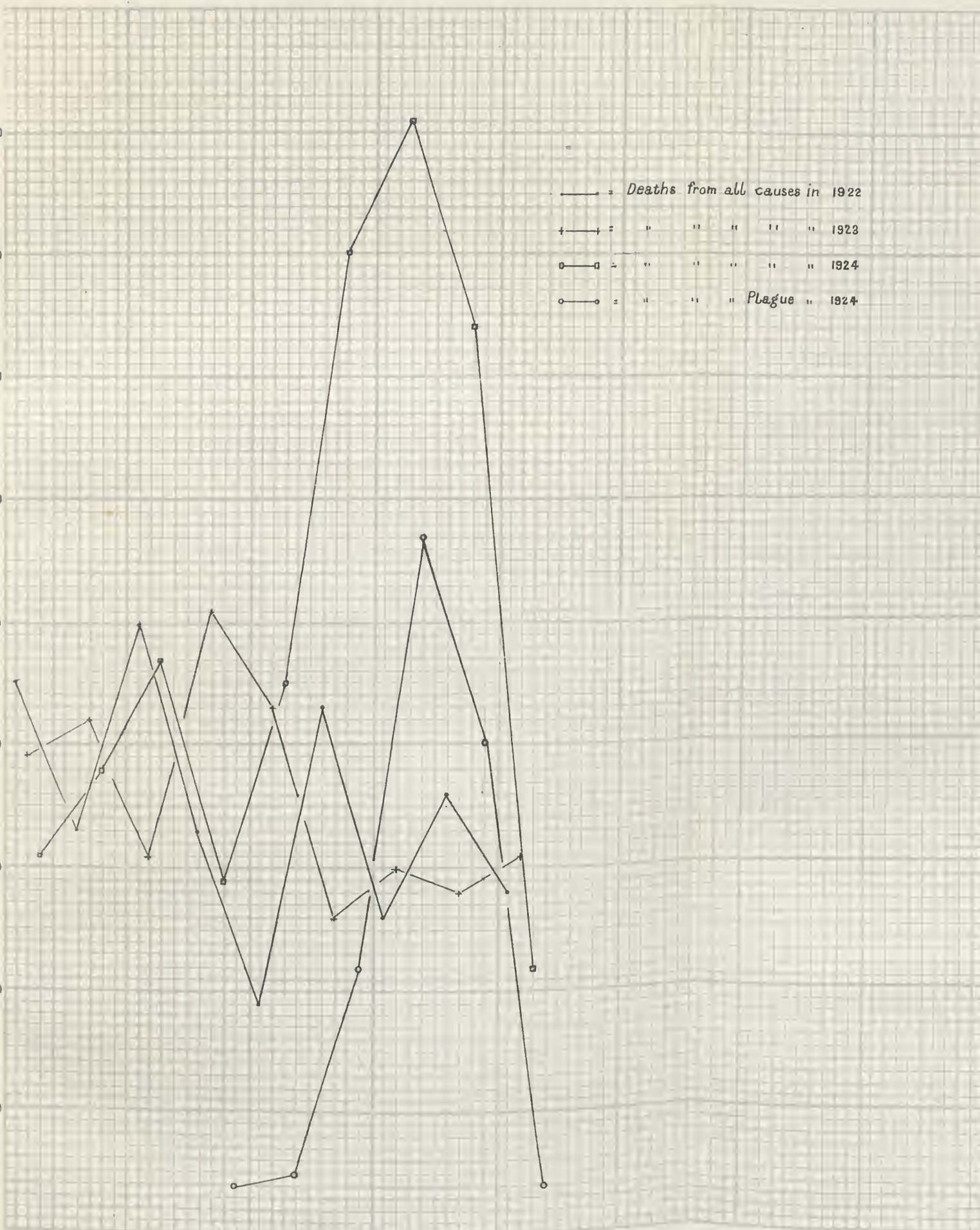


A better type of Ashanti Dwelling. Note louvre windows.

90
80
70
60
50
40
30
20
10

Deaths from all causes in 1922
" " " " " 1923
" " " " " 1924
" " " " " Plague " 1924

Jan. Feb. March April May June July Aug. Sept.



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The area included within the present town boundaries—which are shortly to be extended—amounts to nine square miles. This area is divided into a number of districts. The old town including the Fort, Cantonments and hospitals is surrounded—except for a small area to the west—by low lying and swampy ground. The civilians in this area are mostly Ashantis and the housing conditions leave a great deal to be desired. To the north east of the original old town of Kumasi is situated the Zongo and, of more recent date, the Zongo Extension. At the beginning of the outbreak, and to a somewhat lesser extent still, the houses in this area were most insanitary and highly congested. The Zongo is occupied by Hausas, Lagosians, members of the Northern Territory tribes and by a very small sprinkling of other tribes.

Lying to the west of this is a district consisting for the most part of a fair type of modern native buildings occupied largely by better class Ashantis.

To the south of the Zongo and to the east of the older part of Kumasi lie Bompata and Fanti New Town. This area consists, generally speaking, of a good type of modern building occupied almost exclusively by Fantis.

Still further south are two smaller townships of more recent origin called Bimpeh Hill and New Asafo. These districts are populated for the most part by Ashantis.

A number of Europeans live in a more recent extension southward of the old part of Kumasi. Most of the European officials, however, live on high ground situated to the south west of the main town. Cantonments, situated to the west of the old town accommodates some of the European officers, all the British non-commissioned officers and the rank and file of a detachment of the Gold Coast Regiment.

The population of Kumasi is made up of the following :—

Ashantis.

Fantis.

Hausas, Lagosians, Northern Territory Tribes.

A small number of Gas, Appolonians, Kroos.

Syrians.

Europeans.

The census figures for 1921 are said to considerably understate the actual population which is estimated to be between 25,000 and 30,000.

In support of these figures it may be mentioned that the number of persons coming into and leaving Kumasi was checked on several occasions and the numbers obtained from eleven police quarantine posts on the 15th of September, two days before quarantine was raised, were 7,478 and 7,194 respectively. This number does not include passengers arriving or leaving by train who numbered about 230 and 150 on the same day. Even though a portion of the population is nomadic by nature and though a number of the persons passing the barriers were bringing in market produce, it is not considered likely that the population of Kumasi is less than about four times larger than the numbers coming into and going out of the town.

(III) EPIDEMIOLOGY.

It is not improbable that infection was ship-borne although in no port along the Gold Coast can ships berth alongside a wharf.

When this is rendered possible by the completion of Takoradi Harbour a very real danger will exist of the introduction of plague into the Colony necessitating the taking of precautionary measures.

On the other hand ships can berth alongside a wharf at Lagos, consequently the danger of infection of that port from the sea is very real and at the time of writing a serious epidemic of plague is in progress there.

The sequence of events may have been as follows :—

The Canary Isles became infected from Eastern ports or from Portuguese or French West Africa. Lagos may have become very slightly infected from any of these *foci*. (In parenthesis it is a matter of common knowledge that an epizootic of plague usually occurs amongst rats for sometime before it attacks the human population.)

Moreover, it is quite possible that cases of plague may have occurred in Lagos unknown to the Health Authorities in exactly the same way as unrecognised cases undoubtedly occurred in Kumasi in May.

It is suggested that Sekondi became infected from Lagos or from ships arriving from the Canary Isles or from Portuguese or French West Africa.

According to the interim report on plague at Sekondi "A European, Mr. B, and his servant came to Sekondi on 4th March to the Assizes. They returned to Tarkwa on 7th March, 1924. The Medical Officer was called to see the boy on the 8th, but the boy died before the Medical Officer arrived. The body was examined and the death registered as pneumonia. On the 10th the Medical Officer, Abosso, asked the Medical Officer, Tarkwa, to meet him in consultation of Mr. B. A diagnosis of malaria was made, and Mr. B, was sent to Sekondi Hospital the same day. (The disease later proved to be plague). At Sekondi two kroo boys were admitted to Dr. Maclean's private hospital, they both died on 15th March, 1924, and Dr. Maclean reported both to the Medical Officer of Health as suspected plague. He reported another death on 15th and the Medical Officer Sekondi reported another death on the same day. Since that date, cases have been reported fairly regularly every day. The symptoms are Cervical or Axillary Buboes with or without pneumonia".

The inference drawn from the interim report is that the European and his boy became infected in Sekondi between the 4th and the 7th of March. The boy died on the 8th of March and the European fell sick almost immediately and his disease proved to be bubonic plague.

The subsequent complete absence of plague in Tarkwa and the course of the disease in Sekondi supports this hypothesis.

Thus, the sequence of events from the epidemiological point of view may have been as follows. Either an infected rat or infected fleas were brought up on the train from Sekondi where an outbreak of plague was in progress earlier in the year, or a patient in the incubation stage of plague came up from this port.

A person leaving Lagos or Sekondi could reach Kumasi well within the incubation period.

In the former case the infected rat may have had fleas which disseminated the disease or else the rat may have soiled grain or other foodstuffs with its infective discharges or may have been attacked in its weakened condition by other rats who subsequently became infected so that a widening circle of infected rats resulted.

If no infected rats or fleas reached Kumasi, then the disease may have been started by rats becoming infected by eating the infected dressings or excreta of the original human case supposing that the patient had not had about his person or clothing fleas or other insects by which the disease could be spread. The last suggestion is not very probable since the plague organism is very susceptible to dessication and high temperatures.

It is a matter of regret that shortage of staff prior to the outbreak which forms the subject of this report made the routine examination of rats from different areas of the town quite impracticable. A routine examination of rats brought to the Health Office was commenced on the 23rd of June and was continued daily throughout the epidemic. Had it been possible before this to examine rats trapped in various parts of the town a danger zone no doubt could have been isolated and treated appropriately and simultaneously with surrounding areas.

During the three months 17th June-17th September, a total of 4,939 rats were trapped in various parts of the town. Of these 266 or 5.3% were found to be infected with an organism resembling *B. pestis*.⁴

The rats were of the following varieties :—

Species.	Number trapped.	Number showing signs of plague infected.	Percentage apparently infected.
<i>Rattus Rattus</i>	4,292	241	5.6%
<i>Mus Decumanus</i>	475	24	5
<i>Cricetomys Gambianus</i>	12	1	8.3.
A shrew like rat— <i>Crocidura</i> sp .. (Native Name—Etchwakunowu)	150	0	0
A Striped bush-rat— <i>Mus Babarus</i> (Native Name—Botokwra) ..	10	0	0

The last two types of rodents live almost invariably in areas covered by bush and very rarely enter houses. They are negligible factors in the spread of plague.

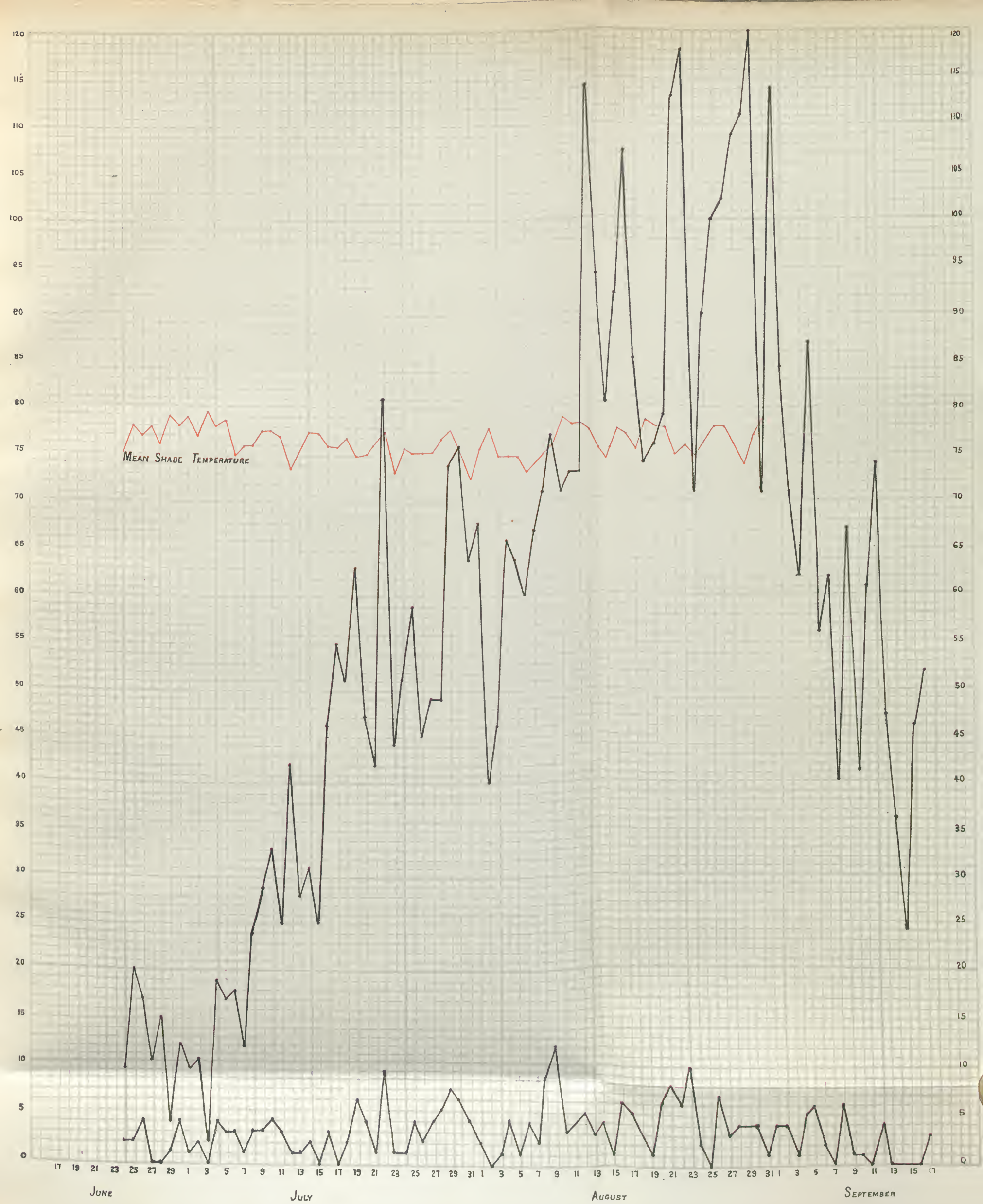
The *Cricetomys* usually lives and nests in open fields, old refuse dumps, etc., but is occasionally to be found nesting in cocoa sheds and enters houses from time to time during the hours of darkness. This type is not of much importance in the spread of plague though it occasionally suffers from the disease as can be seen in the table given above. It may be a danger, however, in keeping up the strain of infection.



A. type of Plague infected compound which was later demolished. Note the verandas and annexes which prevented light and air reaching the living rooms.



Another type of Plague infected premises. The horse was housed in one of the living rooms and sheep, goats, chicken, and pigeons shared the others with the human occupants.



BLACK LINES { TOP: TOTAL (DAILY) NUMBER OF RATS EXAMINED.
 LOWER: TOTAL (DAILY) NUMBER OF INFECTED RATS.

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Mus Decumanus was trapped in larger numbers than the preceding types but was not such a common house rat as the *Mus Rattus*. The natural habitat of the *Mus Decumanus* appeared to be cocoa stores and old refuse dumps.

The *Rattus Rattus* was by far the most common species trapped and on account of its domestic habits was by far the most dangerous variety. This rat was found nesting between the roof and ceiling of the poorer type of mud house and also in the roofs of thatched roof houses. Occasionally, rats' nests were found in the bamboo poles used to strengthen the walls of mud dwellings and even in the middle of mud walls.

In many instances *Rattus Rattus* was found to live in old refuse dumps during the day and to enter houses and stores by night. It is noteworthy that of the very small number of dead rats found on premises—other than those disinfected with Liston Cyanide Fumigator or with the Clayton sulphur di oxide apparatus—in lanes and open spaces, all belonged to the *Rattus Rattus* variety.

An important detail bearing upon the spread of infection from rat to rat and rat to human lay in the fact that fleas were found in extraordinarily small numbers on rats trapped in various parts of the town. Instead of from seven to twelve or even fifteen fleas being found on a rat as was frequently the case amongst rats trapped at Accra, during the period of the writer's service there, as few as three and even none were found on rats caught in Kumasi.

Furthermore, instead of finding the signs characteristic of plague in rats, smears from the spleen showing bacillus pestis were frequently the only evidence available of plague. On many occasions when the spleen and tissues of a rat were found to be free from bacillus pestis the liver was yellowish in colour with small yellowish white areas of necrosis. This, together with periglandular infiltration, enlarged spleen and general congested state of viscera would otherwise have suggested plague. In other cases showing no obvious visceral or glandular lesions bacillus pestis was found in large numbers in smears from the spleen and other viscera.

This is an important detail for two reasons, namely (1) because it demonstrates the necessity for not relying upon clinical appearances and (2) because pathological findings suggested that the disease had been in existence for sometime amongst the rats who had acquired some degree of immunity while still being a danger from the epidemiological point of view.

It is a well known maxim that plague in humans almost invariably follows upon an epizootic amongst rats. No doubt if rats had been trapped in fair numbers from the beginning of the year an epizootic amongst them would have been noted probably from the middle of March onwards.

During the progress of the epidemic under review there appeared to be little correlation between the number of fatal cases of plague and the number of infected rats trapped.

As regards the insect vector the following varieties of fleas were collected from humans and rats.

- (1) *Zenopsylla cheopis*
- (2) *Pulex irritans*
- (3) *Ctenocephalus felis*.

The first variety was found on rats while all three varieties were found on the bodies of infected persons. It is noteworthy that not only were fleas found in very small numbers on individual rats, some having none at all, but fleas were very rarely found on Hausas, Lagosians and members of the Northern Territory tribes though they were found much more frequently on both Ashantis and Fantis. This observation was confirmed by allowing guinea pigs to run about in houses occupied by Hausas, Lagosians or Northern Territory tribesmen when no fleas were found on examination of the guinea pigs after several days exposure.

In view of the fact that the majority of cases of plague occurred amongst the first three tribes it is not unfair to presume that, in the absence of fleas, some other insect carrier must have functioned in the spread of bubonic plague. Northern Territory tribes were frequently found to be infected with pediculi—this observation bearing out facts elicited in connection with an epidemic of relapsing fever in Accra in 1923.

Pediculi, however, were much more rarely found on either Hausas or Lagosians. In no case was a louse found to be infected with organisms resembling the plague organism.

On the other hand bed-bugs (*ornithodoros lectularius*) were found in every single infected house amongst the Hausas, Lagosian and Northern Territory tribes.

Owing to pressure of other more important work it was not found possible to carry out more than one experiment with bugs from an infected house. In this experiment a small number of bugs were removed from the bed-mat upon which the patient had been sleeping

prior to his removal to hospital. All but one of those were examined for the presence of bacillus pestis and all proved negative. The remaining one was placed on a guinea pig. The guinea pig died within 48 hours but smears from the spleen and other viscera were negative for the plague organism consequently the point was not proved.

These negative results, however, did not rule out the possibility of the bed-bugs being the actual vectors in cases of bubonic plague.

Other insects examined as possible vectors were cockroaches, pediculi and insects of the tungidae class. The first were found to be distributed generally throughout the town whereas the latter two were confined to the poorer and more insanitary type of premises. Numbers of all three types of insects were examined for plague bacilli but with negative results.

The proclivity of cockroaches for devouring sputum suggest the possibility of the spread of plague in pneumonic cases by sacks, clothing or food containing insects which have fed on the sputum expectorated by a patient suffering from pneumonic plague being conveyed from one house to another. Similarly, food could be contaminated in the same manner.

It has been suggested that infection might result from a biting insect like a mosquito, sand fly, tsetse fly or other species of biting fly; the writer had ample opportunity of testing this theory as he had occasion to visit the Contagious Diseases Hospital on occasion as early as 5 a.m. and as late as 8.30 p.m. apart from ordinary daily visits. At such times he was bitten by mosquitos and other varieties of biting flies but, apart from becoming infected with the malignant tertian parasite, he suffered no plague infection.

The examination of numbers of dogs and cats excluded these animals from being concerned in the spread of plague except indirectly as providing reservoirs for fleas chiefly, however, of the ctenocephalus variety.

Vultures are alleged to be capable of spreading plague by devouring the bodies of persons who have died of the disease. Large numbers of these repulsive birds are to be found in and around Kumasi the chief reason for their presence being the food they obtain owing to the inefficient system of refuse disposal which results in heaps of damp refuse lying for sometime around the various public incinerators.

The body of a man (Case No. 36) who had died of plague was found early one morning on an incinerator dump where it had been placed by two miscreants who are serving a sentence of hard labour at the time of writing. Apart from this, however, the possibility of infection having been spread by vultures who had fed on dead bodies is remote.

On many occasions, however, these birds were seen on the roofs of houses, and on one occasion the writer and his European Sanitary Inspector observed a vulture rise from a refuse dump with the body of a dead rat in its beak and perch on the roofs of three separate compound houses in the Zongo. Comment is superfluous. As might be expected evidence tended to show that the pneumonic type of plague was conveyed from one person to another by Flügge's droplet method-aerial infection taking place through the respiratory tract—the first case of primary pneumonic plague having resulted from infection from a person who had developed secondary pneumonic infection.

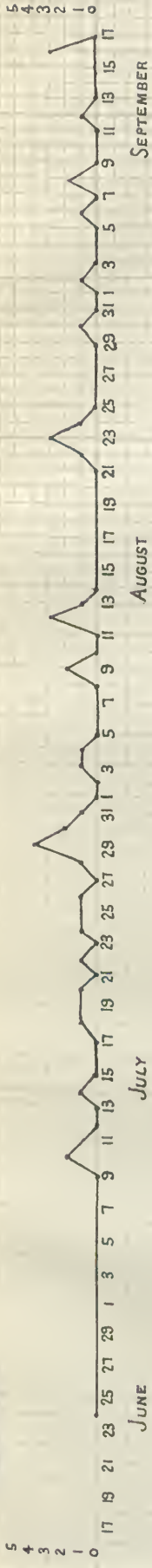
An example of this occurred in Fanti New Town. Case No. 115 died after two days illness suffering from pneumonic plague. In searching the surrounding houses for a possible source of infection the dead body of a woman was found rather more than a quarter of a mile away. The woman, Case No. 116, had fallen sick nine days previously with a femoral bubo. After two days illness she developed what must have been secondary pneumonic plague. She was removed to the house in which she died but not before she had infected Case No. 115.

On carrying out post mortem examinations on both these cases it was found that the woman had developed a secondary broncho-pneumonia while the man had died of a primary infection as the result of coming in contact with the woman before she was removed from the house.

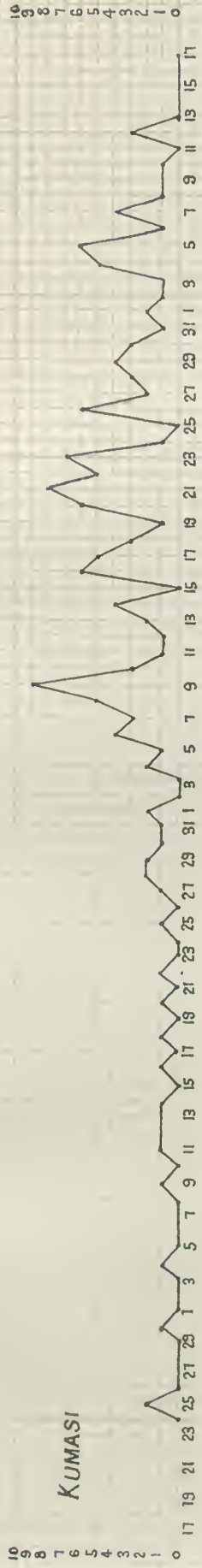
There can be little doubt but that the cases of pneumonic plague that occurred in Kumasi would have given rise to a vastly more serious epidemic but for the vigorous policy undertaken of protecting the inhabitants as far as possible by vaccination and by enforcing greatly improved ventilation and lighting all over the town.

That the danger of infection in the pneumonic type was real is proved by the death of a volunteer nursing orderly at the Contagious Diseases Hospital early in the outbreak. That vaccination conferred a fair degree of immunity was proved by the writer who attended the many primary and secondary cases of pneumonic plague in the Contagious Diseases Hospital without wearing a mask. The reason for this apparently foolhardiness lay in the writer's fear that the attendants whom he insisted should always wear masks, overalls and gum-boots, might be panic stricken.

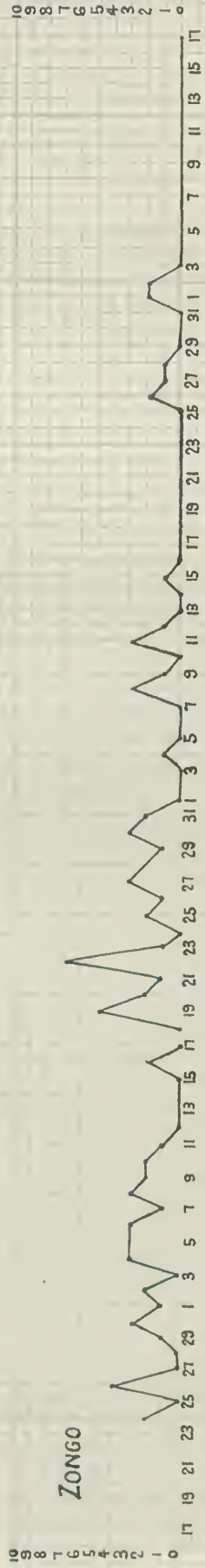
BANTAMA



KUMASI



ZONGO



DAILY NUMBER OF INFECTED RATS FROM DIFFERENT AREAS

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Insanitary conditions arising from mud huts being built over entire compound. Five cases of plague were removed from these hovels.



The above after removal of hovels. A few the occupants of the compound can be seen.

An important epidemiological factor was the temperature and relative humidity. The temperature remained between 72.5° and 79.5° for the whole period of the epidemic. The relative humidity varied to some extent but was usually in the neighbourhood of 74.84.

It is evident, therefore, that the optimum temperature and humidity for both the flea and also the bacillus were maintained consistently throughout the epidemic.

The outbreak commenced about the beginning of the rainy season and progressed all through the heavy rains.

During the period comparatively low temperatures were recorded and on many early mornings the town was covered in a cold mist. Such conditions were not only favourable to the development and life of the flea and the plague organism but rendered dissemination of infection more probable owing to the fact that, feeling cold, the African population endeavoured to become warmer by closing every nook and cranny in their houses thus shutting out effectually both light and air.

(IV) CONTRIBUTORY FACTORS RESPONSIBLE FOR THE OUTBREAK OF PLAGUE IN KUMASI, 1924.

These factors will be described very briefly since they are dealt with more fully in the various sections forming the body of this report.

The writer is anxious that the following statements should not be considered in any way whatsoever as a criticism of his predecessors. Having worked in Kumasi for a few months the writer can appreciate the difficulties with which his predecessors have had to contend in the past.

(1) A serious outbreak of plague broke out in Sekondi in early March, 1924.

(2) A large number of passengers arrived from Sekondi in Kumasi weekly. My predecessor stated in his report on the first outbreak in Kumasi that during the period 14th March—5th May some 564 passengers arrived in Kumasi by train from Sekondi.

(3) Large quantities of rat and flea-favoured merchandise were brought to Kumasi by goods and passenger trains from Sekondi during the period when this port was in quarantine.

(4) The goods shed at Kumasi was within a short distance of Kumasi Old Town and various stores including that of the Union Trading Company which was over-ridden with rats at that time.

(5) The first case of plague occurred in a man working in this store and resident in the old portion of Kumasi referred to in (4).

(6) Between the goods shed and the area in which cases of plague occurred was situated a large refuse dump with two incinerators both of which were in a damaged condition and failed to function. Judging from the conditions prevailing in the neighbourhood of this incinerator and dump when the writer arrived, the dump must have harboured a large colony of rats.

(7) Out of the nine recognised fatal cases of plague that occurred in the first outbreak from the first of April to the 9th May seven occurred in this neighbourhood while an isolated one occurred at Old Asafo and a second in Bimpeh Hill Extension.

(8) On the writer taking over duties of Medical Officer of Health on the 12th of June, he discovered that seven deaths had occurred in one compound in the Lagosian section of the Zongo Extension between the 28th of May and the 9th of June. There can be little doubt but that these deaths resulted from plague since the writer discovered three fatal cases of plague during the next six days in a house some 20 yards away from the compound in which the seven deaths had occurred.

The deceased had lived from two months to fifteen years or more in Kumasi and the only possible connection between these cases and those of the first outbreak rested in the fact that certain of the deceased were kola traders and had had occasion to visit the goods station—near the originally infected area—from time to time with the object of sending the kola by train to Sekondi.

(9) Five out of the seven deaths mentioned above occurred without the knowledge of the Health Officer and the bodies were buried without a permit and naturally no anti-plague measures were taken at the time. This unfortunate occurrence, which led to a widespread outbreak of plague in Kumasi, was attributable to the quite inadequate sanitary staff that the Health Officer had to assist him. In voicing this opinion the writer fully realises that the inadequate staff was due to the small numbers of trained sanitary inspectors allowed throughout the Colony owing to the need for strict economy.

When the writer assumed duties in Kumasi the sanitary staff under him comprised a European Superintending Sanitary Inspector, a First Division African Sanitary Inspector, and six Second Division African Sanitary Inspectors.

Estimating the population at between 25,000—30,000 it will be evident that each sanitary inspector had between four and six thousand persons to care for.

In effect, an inspector was not able to inspect any one house more than once in every second or third week. Thus the sanitary inspector in charge of the compound where seven persons died within a fortnight and where five were buried without a permit was completely ignorant of the fact until after irretrievable damage had been done and plague had spread to several foci.

Inadequate sanitary staff was thus an important contributory factor.

(10) In addition to inadequate sanitary staff the European Building Inspector's department was so understaffed that insanitary buildings and additions to the buildings were found all over the town and particularly in the Zongo and Zongo Extension.

In the middle of June a very small minority of houses, stores, etc., either in the Zongo and Zongo Extension or in the new layouts and in Kumasi Old Town had any means of lighting or ventilation in their living and sleeping rooms. Moreover, unauthorised buildings were to be found everywhere, sometimes filling lanes, or almost completely filling the compounds of houses. Furthermore, it was a common sight to see verandahs built up in the back and front of a building, completely enclosed and subdivided into absurdly small cubicles with the result that the persons in the inner rooms were deprived of both light and fresh air. The damp darkness of such places was naturally incompatible with good health and provided excellent conditions for infection and dissemination of a disease of the nature of plague.

(11) Many houses were rendered still more insanitary by the custom of keeping animals, sheep, goats and horses not only in the compounds but in the living rooms. Apart from the effluvia etc., arising from the excreta-sodden floors of such rooms the fodder and litter used for such animals,—particularly guinea corn and mealies for the horses—resulted in ideal conditions for the attraction and breeding of rats.

(12) In certain compounds where a trade was carried on in maize, flour, cassada, koko yam, plantains etc., large stocks of foods were kept thereby attracting rats from the surrounding area.

(13) Taken as a whole all the houses were grossly overcrowded thus, 69 persons were found in one compound where a case of plague occurred. Under such conditions of overcrowding the possibilities of dissemination of infection were very great.

(14) Kumasi would appear to have grown very rapidly in size during the past few years.

Unfortunately, financial considerations appear to have been such as to make the provision of adequate sanitary structures impossible. As a result of this, new townships have sprung up as in the Zongo Extension, Bimpeh Hill, New Asafo, Osofokrom etc., without any provision whatsoever having been made in the way of latrines, incinerators, drying sheds, bath houses etc. Moreover, in such areas as Fanti New Town, Ashanti New Town, the Zongo and Kumasi Old Town the sanitary structures were entirely inadequate for the needs of the population.

For example latrine accommodation was in proportion of one "seat" for approximately sixty persons instead of one "seat" for every ten persons.

The inevitable result of the lack of these essential sanitary structures was the fouling of lanes, open spaces, and the surrounding 'bush' so that areas of Kumasi were little better than an open latrine.

In the same way the absence of incinerators and dustbins or drying sheds in some areas and the inadequate number of such structures in other areas led to refuse being dumped in vast quantities on open spaces and in lanes and the surrounding "bush." As a result, areas of Kumasi were converted into a series of refuse dumps in addition to being open latrines.

In connection with the existing incinerators the writer feels bound to criticise the system very severely. The smoke from such incinerators is in itself a nuisance and injurious to health placed as they are in residential and commercial areas. Moreover, the rainfall of Kumasi is so heavy (about 60 inches per year) that the refuse, which, in any case is to a large extent made up of green plantain skins and similar material, becomes damp and sodden and will not burn at all satisfactorily. The provision of so-called drying sheds does not solve this difficulty, for in order to become dry enough to burn refuse would have to be left in the sheds for days on end and would provide a breeding ground for flies and an attraction for the rats of the neighbourhood. As a result of the inability to burn a proportion of the refuse—a large proportion during the rainy seasons—and in any case the impossibility of destroying tins and bottles, the digging of pits around the incinerators in



View to show portion of Zongo and Zongo Extension.



Another view of Zongo and Zongo Extension.

which to bury such tins, and bottles and the indestructible refuse has had to be resorted to. In this way much valuable land is spoilt and the dumps so formed provide excellent breeding and feeding places for large colonies of rats. The writer strongly maintains that all refuse should be cleared twice daily from rat-proof and fly-proof bins and removed outside the town area to low lying places where it could be fired and used to fill in swamps.

(15) In that ill-health on the part of a population is a contributory cause of an outbreak of disease the writer considers that the conditions under which food was sold in the market and in which water for drinking and washing purposes was obtained both constituted contributory causes of the outbreak. With regard to the native food supply, this was sold for the most part in two markets. One, the Zongo Market, consisted of a large number of " buggas " or hovels made out of old sacks, old matting, kerosene tins etc. These were scattered all over the market rendering sweeping almost impossible. These hovels were occupied by vendors by day and by lunatics, lepers, other diseased persons and wastrels and homeless by night. The main Kumasi Market was little better than this being situated in a congested and insanitary area, grossly overcrowded, and with its surface such as to make cleansing or even sweeping quite impracticable.

(16) As regards water the main European source was found to be fouled by water percolating through an old graveyard, and contained a large night-soil depot in its catchment area. In addition, this water was found to be carried by head load in uncovered tins. It was by no means an uncommon sight before steps were taken in the matter to see a gang of water boys carrying uncovered drums of water on their heads pass a squad of prisoners with uncovered drums of nightsoil on their heads.

The main African water supply was similarly found to be fouled repeatedly by persons dipping in large numbers of indifferently clean buckets. The catchment area in this instance was found to be fouled by herds of cattle etc., grazing on the margins of the wells.

(17) Legal powers for the abatement of various nuisances and injuries to the public health were not sufficiently comprehensive and recommendations were made in consequence that Chapter 55 and 65, Laws of the Colony, should be applied to the Town and that offences for failing to report deaths and infectious disease should entail heavier penalties.

Lastly, the unprotected state of the population from plague was no doubt a contributory cause—little more than 2,000 anti-plague vaccinations having been given previously during the earlier outbreak in April and May.

The following table illustrates the effect of vaccination on the number of deaths from plague.

				Deaths from plague.	Vaccinations.
17-23	June	..	..	11	1,779
24-30	"	..	..	10	5,224
1-7	July	..	..	21	18,865
8-14	"	..	..	14	9,491
15-21	"	..	..	7	6,624
22-28	"	..	..	11	6,224
29-4	August	..	..	17	4,231
5-11	"	..	..	16	5,838
12-18	"	..	..	6	9,907
19-25	"	..	..	5	8,543
26-1st	September	..	..	2	7,953
2-8	"	..	..	1	6,481
9-15	"	..	..	0	6,573

(V.)—THE ORIGIN OF THE JUNE OUTBREAK OF PLAGUE IN KUMASI AND THE SUBSEQUENT DISSEMINATION OF INFECTION TO VARIOUS DISTRICTS OF THE TOWN.

Little doubt remains in the mind of the writer that the outbreak of plague in Kumasi in June, 1924, was intimately associated with the outbreak that occurred in the town in the previous April and May. A brief description of this first outbreak which occurred prior to the arrival of the writer in Kumasi is therefore of interest.

The first recognised case of plague in Kumasi in 1924 was reported by a private medical practitioner, Dr. W. E. Masters, who had admitted an adult male Ashanti resident in Kumasi Old Town to his private hospital on the 30th of March. The man died on the night of the 31st March—1st April and death was shown to have resulted from plague.

The deceased was employed at the main Kumasi store of the Union Trading Company situated between the deceased's house and the Goods station. The store appears to have been over-run with rats at the time but no dead rats were noted by the European agent.

Large consignments of foodstuffs had been received by the firm during the earlier months of the year and almost all had come by rail from Sekondi which had been in quarantine for plague from 14th of March to 8th of May.

The second case of this series occurred in a street adjoining that in which the first man died.

A brother of the first case who also worked in the same store died on the 30th of April in the same area of the town. The cause of death was given as heart failure but as five fatal cases of plague occurred within a few days in the same house it is probable that the man died of plague. Some little distance from the same part of Kumasi Old Town two further cases of plague occurred.

It is suggested that the first case of this series was probably infected through infected rats brought up in rat-favoured merchandise on the railway from Sekondi early in March during the time when a serious epidemic of plague was in progress in Sekondi—the merchandise being consigned to the principal store of the Union Trading Company in Kumasi—and that this case gave rise to the remaining eight recognised cases the last of which was reported on the 9th of May.

The other possible sources of infection are as follows :—

(1) Rat-favoured merchandise landed at Sekondi from ships which had called at ports on the French Ivory Coast where plague is endemic.

(2) Rat-favoured merchandise landed from ships arriving from the Canary Islands which were infected with plague at the time.

(3) Rat-favoured merchandise landed from ships arriving from Lagos where ships can tie up right alongside quays.

(4) Rat-favoured merchandise landed from ships that had touched or taken on cargo at the many eastern ports where plague is endemic.

(5) Labourers, traders and others from the French Niger, Senegal or Ivory Coast where plague in epidemic form is often met with. Ambulant cases of plague not necessarily infective but having infected fleas on their bedding or clothing and convalescent cases of the disease still bearing infected fleas may have come to Kumasi across the border to escape military service or compulsory labour in French Territory.

The fact that no places were found within a long radius of Kumasi where plague had occurred, with one exception where the case was traced to an infected house in Kumasi, would militate against the last possible source. (Reports of sickness at Ejura, Kintampo, Nkoranza, Mampong, Effiduase, Juaben, Agona, Juaso and other places outside Kumasi were all investigated from time to time with negative results).

The source suggested in (4) *supra* is also rather remote and need not be considered.

That plague may have originated from Lagos is possible, for much traffic of Kola merchandise and Lagosian cloths goes on between Kumasi and Lagos *via* Sekondi.

It is more probable, however, that Lagos became infected from Sekondi.

In connection with the ship-borne plague the following occurrence is of interest.

The Town Engineer of Kumasi (Major McAndrew) left England on the 9th of July bringing out on board with him a new Standard car.

This car was over-carried in error to Lagos where ships may berth against the wharf. The car was brought back on the 2nd of August, landed at Accra and at once sent up by rail to Kumasi. Immediately on arrival the car was inspected and found to have a rat's nest in the bonnet close to the carburettor. The car was inspected before leaving England and was only on the beach at Accra for a few hours. It is improbable that the rat's nest was made in the railway truck on the way up in the goods train from Accra.

Thus the nest would appear to have been made on board during the voyage or while the ship was berthed at Lagos.

No suggestion is made that the above occurrence, which took place long after Kumasi became infected with plague, had any connection with the outbreak, but it does undoubtedly suggest a possible avenue of dissemination of infection.

From reports received by the writer while Medical Officer of Health, Accra, from masters of ships putting into port after touching at ports along the French Ivory Coast, it would appear that an endemic area for plague exists in the Ivory Coast. Moreover, it is to be regretted that information of the existence of outbreaks of plague on the Ivory Coast are not always reported as promptly by our neighbours as they should be. A serious outbreak of plague occurred in Dakar and District in 1921, but, as far as the writer remembers, there was no official notification from the French Authorities until the outbreak had been in progress some little time.



Kumasi Market. Congested and difficult to cleanse.



Site for New Kumasi Market. The area was originally a malarious swamp.



Another important water supply of Kumasi in 1924. Note Use of many dippers, broken coping, cracked wall and surrounding puddle.



The Odum Wells — The chief water supply of the Native population. The well in the foreground is reserved for Europeans. Many dippers are used and the water is liable to fouling.

While land traffic from neighbouring French Territory to the west is comparatively large, the fact that no outbreaks of plague have been notified from the frontier zone would tend to negative this as a route of infection.

On the 12th of June when the writer took over the duties of Medical Officer of Health, Kumasi, information was received that seven deaths had occurred between the 28th of May and the 9th of June in a native compound situated in a part of the town area laid out as an extension to the Zongo. Out of these seven deaths which had occurred in a compound of thirty persons all of whom had resided in Kumasi for two months or more, five bodies had been buried without any notification to the Deputy Registrar of Deaths and without burial permits. The remaining two deaths had been certified by medical practitioners as being due to tuberculosis and dysentery. In the light of subsequent events—*vide* under "Diagnosis"—it is probable that all these deaths were due to plague.

This statement is based upon the fact that the first three cases of plague occurred in a house situated within 20 yards of the premises in which the seven deaths had occurred in the short period of a fortnight; that as many as 48 out of the total 140 cases dealt with in this report subsequently occurred in the same area; and, lastly but more important still, the supposition received the support of Sir William Simpson when he honoured Kumasi with a visit.

The above taken in conjunction with the fact that nine cases of plague, all ending fatally, had occurred in Kumasi between the 31st of March and the 9th of May and that the recorded deaths for the first two-thirds of the month of June amounted to 46 whereas the corresponding figures for the whole month in 1921, 1922 and 1923 were only 36, 44 and 26 respectively, led the writer to the assumption that some acute and fatal infectious disease was prevalent in the town and that the disease was, in all probability, plague. Subsequent events proved that this surmise was correct.

Thus, there would appear to be little doubt but that the first three cases of plague in the outbreak under review owed their origin to infection from the premises where 23.3% of the inhabitants had died in the short space of fourteen days. Before these died, however, it is known that they were in the habit of visiting the Zongo Market daily to purchase foodstuffs and that they visited friends in other parts of the Zongo and Zongo Extension. The probability exists that they visited these areas during the infective stage of the disease and this probably accounts for the fact that the disease was so widely spread.

The fourth fatal case was found in Kejetia, a part of Kumasi Old Town, in a compound house occupied by a Mohammedan of Northern Territory tribe who had been a frequent visitor to the infected area in the Zongo and who had also been in the habit of going to the Zongo Market.

No further cases occurred in Kejetia for a considerable period and thus it is permissible to attribute the infection of the fourth case to the infected portion of Zongo Extension or to Zongo Market.

The fifth fatal case occurred in Zongo Extension close to the original infected area, while the sixth occurred in the Zongo near to the Market which at that time consisted of a number of insanitary "buggas" or hovels occupied partly by vendors and partly by diseased persons, lepers, lunatics, and by a large rat population.

The early definite cases of plague had made use of this Market and were probably responsible for the Zongo itself becoming infected.

Several other cases occurred in the Zongo in the vicinity of the Market, although one (case No. 12) was removed to the Contagious Diseases Hospital from a house in Bank Road, Kumasi; but it was found that he had been carried there two hours earlier from a house near Zongo Market close to that in which Case No. 6 died.

Fanti New Town was the next area to be infected but only to a small extent owing to the better type of building and to the generally better sanitary conditions prevailing there. The portion of this District to be infected in the early part of the epidemic adjoined the infected area of the Zongo and direct infection by plague rats may have occurred or else infection may have resulted from the use of Zongo Market by a portion of the inhabitants of Fanti New Town as being more convenient than the more distant Kumasi Market. In some cases occurring in Fanti New Town it is possible that infection arose from certain houses of ill-fame in the infected area of the Zongo which young men were in the habit of frequenting.

Cantonments was the next area in which a case of plague occurred. Early in the outbreak the Zongo and Zongo Extension were put out of bounds to troops, and picquets were established on three of the main roads of approach from Cantonments to the infected area. It is possible, however, that a certain small leakage occurred and that a small number of men from Cantonments entered the Zongo. In any case the women and children from Cantonments could not be prevented from going to and fro to the Zongo and Zongo Market and a certain number of civilians no doubt visited the troops in the lines.

No further spread of the disease took place in Cantonments although at a later date two further cases clinically resembling plague occurred among the troops. These cases failed to give positive bacteriological tests and although action was taken as though they were cases of plague they were not reported officially as such.

At the end of July a case (No. 68) died in Fanti New Town. The deceased is thought to have acquired the disease in the Zongo, since he is suspected to have visited a house of ill-fame there.

About the same time a case of plague (No. 79) occurred in Bantama. The man was known to have taken part shortly before in an unauthorised funeral custom over a death which proved to have resulted from plague.

On the other hand numbers of plague infected rats had been found in Bantama for a few weeks prior to the death of Case No. 79 and consequently the deceased may have been infected in that area.

Early in August three cases of plague occurred in Kumasi Old Town,—one (Case No. 89) in Kejetia, one (Case No. 93) north of the Police Barracks and one (Case No. 104) west of the Meat Market. In none of these cases was there any spread partly on account of the population having been protected by vaccination and partly on account of the better housing conditions. In the first case the boy was stated to have been a frequent visitor to the Zongo Extension with his elder brother and may have acquired infection there. The second case may have been infected while carrying out plague duty in the infected area, while the third case was a sanitary labourer who had accompanied the sanitary inspector in charge of an infected district in house-to-house inspections.

About the middle of August a girl (case No. 103) died in Ashanti New Town and her body was carried to a house near Zongo Market. As she had been in the habit of frequently visiting her father at the Zongo residence it is probable that she became infected while in the Zongo. No further cases occurred in Ashanti New Town.

Towards the end of August cases began to occur in Fanti New Town. The source of infection was either an extension by rats from the adjacent infected areas in the Zongo—a number of plague infected rats had been found in Fanti New Town some weeks before the case referred to occurred—or from a continuation of infection in the strain of rats infected during the occurrence of Case No. 68.

The first case of this series (Case No. 115) was undoubtedly infected by Case No. 116 who had resided on the premises of Case No. 115 until six days previously. Case No. 116 had been removed to the house where her body was found by the writer while carrying out a house-to-house inspection in the neighbourhood of that in which Case No. 115 had died. Case No. 116 was found to have a large femoral bubo and secondary pneumonic plague. Case No. 115 died of a primary pneumonic infection of two days duration.

The third case of this series (No. 119) was resident in a house adjoining that to which Case No. 116 had been carried and where she had died.

Osofokrom, west of Ashanti New Town, was the site of the last fatal case of plague (No. 121) that occurred during the outbreak under review. Here, there were a collection of somewhat insanitary dwellings occupied by Hausas and Northern Territory Tribes who were frequent visitors to the Zongo Extension. Infection is believed to have been acquired from this source.

From time to time cases were discovered in whom infection appeared to have taken place outside Kumasi *e.g.* at Attabubu, Kintampo, etc. But these areas were visited later and no evidence of plague could be found in them, consequently it is doubtful whether such cases were not infected in Kumasi.

(VI) SYMPTOMATOLOGY.

I. INCUBATION PERIOD.

It is generally agreed that the incubation period of plague varies from two to five days though the period has been stated by an eminent authority (Sir William Simpson) to extend to twelve days.

The following cases are of interest in connection with the incubation period of plague.

Case No. 33 was admitted to hospital on suspicion on the 2nd of July and developed a femoral bubo soon after admission. Secondary pneumonic plague supervened on the 4th of July and ended fatally on the following day. This case was nursed by a nursing orderly who had come in contact with cases of plague for the first time on the 29th of June when he



An important water supply. Note refuse dump, incinerators, latrine and bath house in background.

MORNING & EVENING.

Bubonic Plague

NOTES OF CASE

NAME { *Mama* *Ma/e*

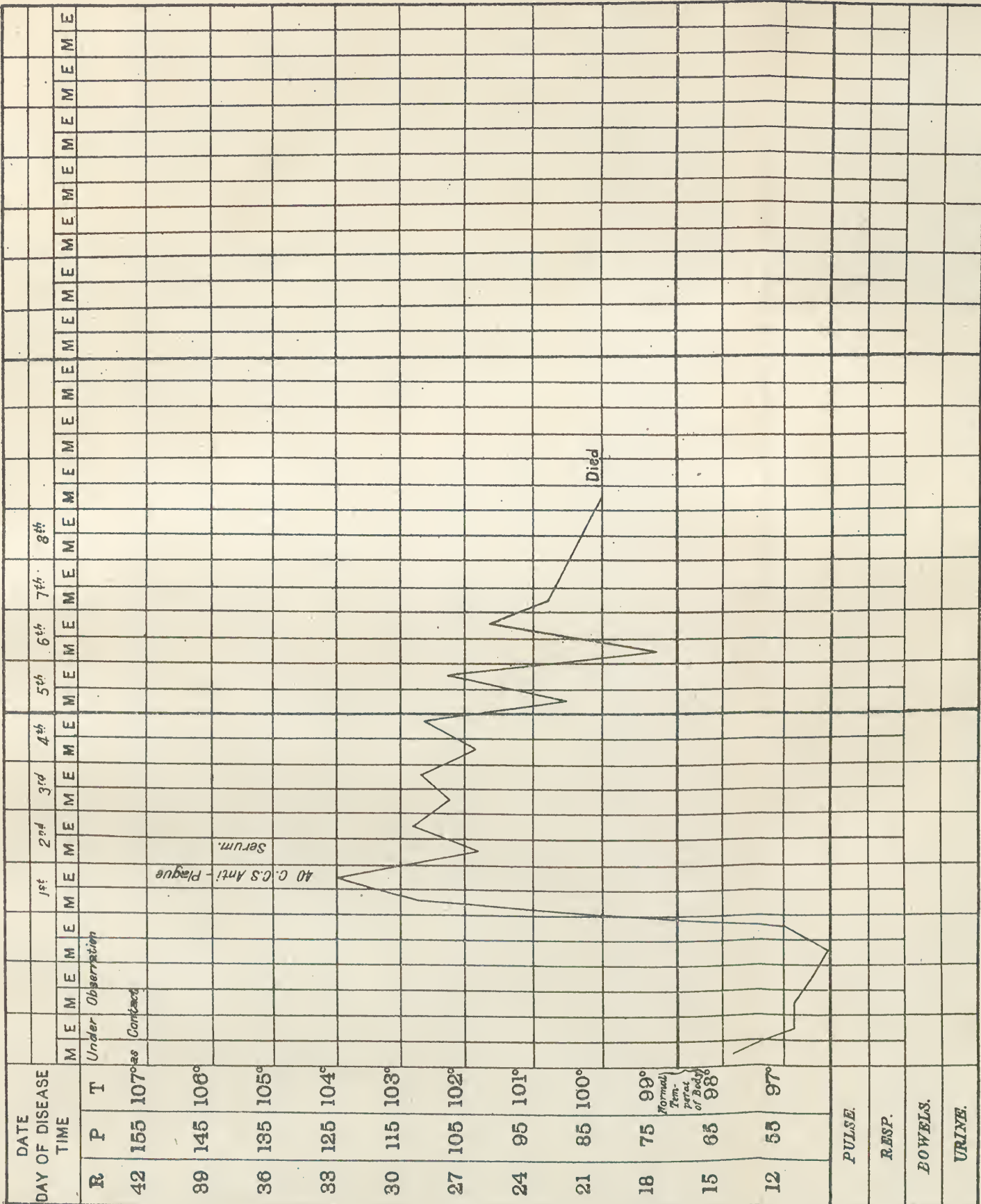
AGE 28 Years

DIET Milk

CASE BOOK No. 2.

DATE OF ADMISSION

RESULT..



Drawn and Printed at Survey H^d. Q^{ry} Accra, 1925.

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volunteered for duty at the Contagious Diseases Hospital. The nursing orderly who had been inoculated on the 20th of June, was quite well until the night of the 11th of July when he developed a raised temperature and was found to be suffering from pleurisy. The orderly was isolated in a room by himself but was transferred to a ward in the hospital on the 12th of July when he had well marked signs of pneumonic plague with very numerous bacilli resembling *bacillus pestis* in his sputum. He died at 2 p.m. on the 13th of July. The incubation period in this case was probably about six days.

In a second case an adult male (Case No. 43) arrived in the Zongo from Attabubu on the 6th of July. On the following day he fell sick and died within 24 hours of primary pneumonic plague. In this case the incubation must have been less than 36 hours.

In a third case a young boy (Case No. 52) arrived in the Zongo on the 6th of July from Juaso where he had been living for the past six months. He was found to have died of bubonic plague on the 12th instant. As the femoral bubo must have been at least of two days duration it would appear that the incubation period in this case was about four days.

2. CLINICAL TYPES.

Three types of plague were encountered during the epidemic. (a) Bubonic. Out of the 140 cases proved bacteriologically to be of plague infection 90 or 64.2% were of this type. This type can be further subdivided according to the following table:—

<i>Situation of bubo.</i>	<i>No. of Cases.</i>	<i>Percentage.</i>	<i>Mortality.</i>
Femoral	69	76.6	86.9%
Axillary	12	13.3	50%
Cervical	5	5.5	80%
Inguinal	2	2.2	Nil
Subclavicular	1	1.1	100%
Epitrochlear	1	1.1	Nil

In connection with the above it should be borne in mind that in a minority of cases a second bubo developed in another situation of the body. For the purposes of the above calculation the site of the initial bubo alone is given.

The mortality of this type of plague was 78.8%. If three cases of suspected bubonic plague in which bacteriological tests were negative but clinical symptoms and reaction to specific treatment strongly suggested a diagnosis of plague, are considered together with the remainder giving positive bacteriological tests, then, the mortality of this type is found to be slightly lower or 76.3%.

Owing to the numerous tribes to which the patients belonged and to the necessity at times of employing as many as three interpreters, some difficulty was experienced in arriving at a correct idea with regard to symptoms.

In one case only of bubonic plague was an initial lesion found. Case No. 119 was found to be suffering from a cervical and an axillary bubo on admission. In addition, a small circular vesicle about one-third of an inch in diameter was found on the flexor surface of the middle third of the forearm of the side where the axillary bubo was present. The vesicle rose gradually from the skin and appeared to be multilocular and to contain a clear straw-coloured fluid. This fluid was examined and was found to contain a pure culture of *bacillus pestis*. The vesicle had not completely dried up before the case died.

In cases of bubonic plague that came under observation the onset appears to have been sudden without prodromata and accompanied by headache, vomiting, shivering, raised temperature, rapid pulse, very marked giddiness suggesting an alcoholic intoxication, restlessness in the early stage to be followed by rapid prostration or a noisy and active delirium.

The following may be taken as a typical, severe case. Case No. 50, Mariama, aged seven years, resident in the Zongo and a contact with case No. 36 who died on the 6th of July was vaccinated with anti-plague vaccine on the 7th of July. The child was medically examined daily and appeared to be quite well until the 11th of July when at 8.30 a.m. the writer found that she had developed a raised temperature but was still bright and active. The child was removed to the Contagious Diseases Hospital but by 6 p.m. on the same day she had developed femoral buboes and was unconscious with marked head retraction suggesting a case of meningitis. Within about thirty minutes of receiving minims V of tr. iod. mitis intravenously she recovered consciousness but she died the same night at 1 a.m. after being ill for about 18 hours.

It is possible that in the above case the severity of the symptoms may have resulted to a certain extent from the negative phase succeeding the administration of plague vaccine.

Similar cases occurred in many others where there was no question of a negative phase.

For example, Case No. 114, Fatuma, female, aged 8, resident in the Zongo Extension was seen playing and was apparently in good health on the morning of the 18th of August. Towards evening she complained of headache and pain behind the mandible. A swelling appeared in the submaxillary region about 6.30 p.m. The patient died the same night after less than 12 hours illness and the autopsy proved conclusively that death had resulted from plague.

In cases of bubonic plague the bubo appeared in one to three days from the onset of the disease. Inspection of the table given above shows that femoral buboes were the most common. Axillary buboes were encountered in fewer numbers while cervical buboes were rarely seen. Among unusual sites may be mentioned the case of subclavicular and epitrochlear buboes.

Occasionally, more than one region of the body was affected as for example Case No. 104 where cervical and femoral buboes occurred and Case No. 119 where cervical, axillary and subclavicular buboes occurred.

The bubo itself varied in size from one to five inches in its long axis. Whether large or small such buboes were acutely tender and patients were found to place themselves in one fixed position with, in the case of the lower limb, the thigh flexed on the abdomen and abducted and rotated outwards and with the knee flexed on the thigh.

Surrounding infiltration was considerable.

In the majority of cases the spleen was palpably enlarged and the liver was also enlarged and tender.

In cases where the patients recovered, resolution of the bubo gradually occurred lasting about four weeks. In other cases suppuration supervened usually after seven to ten days and large sloughs of the matted glands and the surrounding tissue were formed even after aspiration followed, when necessary, by free incision and packing. Convalescence was delayed in these cases and deep seated boils and carbuncles were a frequent sequela.

In unfavourable cases prostration increased, sordes appeared on the mouth and lips, the tongue, covered with brown fur in the early stage, became dark brown and dry and haemorrhages occurred from the mouth and nose. Many of the severe cases suffered from diarrhoea from the start and, when prostration was severe, incontinence of urine and faeces occurred. Delirium was common in adults although some of the most severe cases were fully conscious and intelligent right up to the end when cardiac failure usually supervened.

The temperature recorded in the cases of bubonic plague followed no definite course. Generally speaking high temperatures were found at the onset the highest occurring in Case No. 82 who had a temperature of 105.2 on admission to hospital. In the majority of fatal cases the raised temperature persisted until death ensued but in some the temperature fell to subnormal just before death. In several cases that recovered the temperature fell to normal about the sixth day of the illness except where buboes suppurred when the raised temperature persisted until the 12th or 14th day of the illness.

The average duration of stay in hospital of these cases was 42.2 days in the case of males—the longest stay being 52—41.5 in the case of females—the longest stay being 46.

(b) In cases of pneumonic plague the onset of the disease appeared to be still more sudden.

Case No. 55 discussed above in connection with the incubation period illustrates the point.

The following cases also illustrate the sudden onset and rapidly fatal end in cases of pneumonic plague.

Case No. 60 was found reeling about in the street and died before he could be removed to hospital. The deceased was sick for less than 24 hours.

Case No. 76 was seen by the writer on the morning of the 29th of July. She appeared to be quite well and had no raised temperature. At midday the case developed a cough and pain in the chest. She was seen by the writer again at 6.30 p.m. on the same day and found to be suffering from broncho-pneumonia, bacillus pestis being present in a sample of sputum. The patient died in hospital at 3.15 a.m. on the 30th of July less than 15 hours from the onset of the disease.

Among the 29 cases of primary and secondary pneumonic plague that occurred all proved fatal with the exception of one. This was a patient admitted to hospital on the 2nd of August, suffering from a femoral bubo which later required incision and drainage and in whom a so-called plague carbuncle occurred. This case developed signs of broncho-pneumonia within 24 hours of admission to hospital and expectorated blood-stained sputum which was found to be swarming with organisms resembling bacillus pestis.

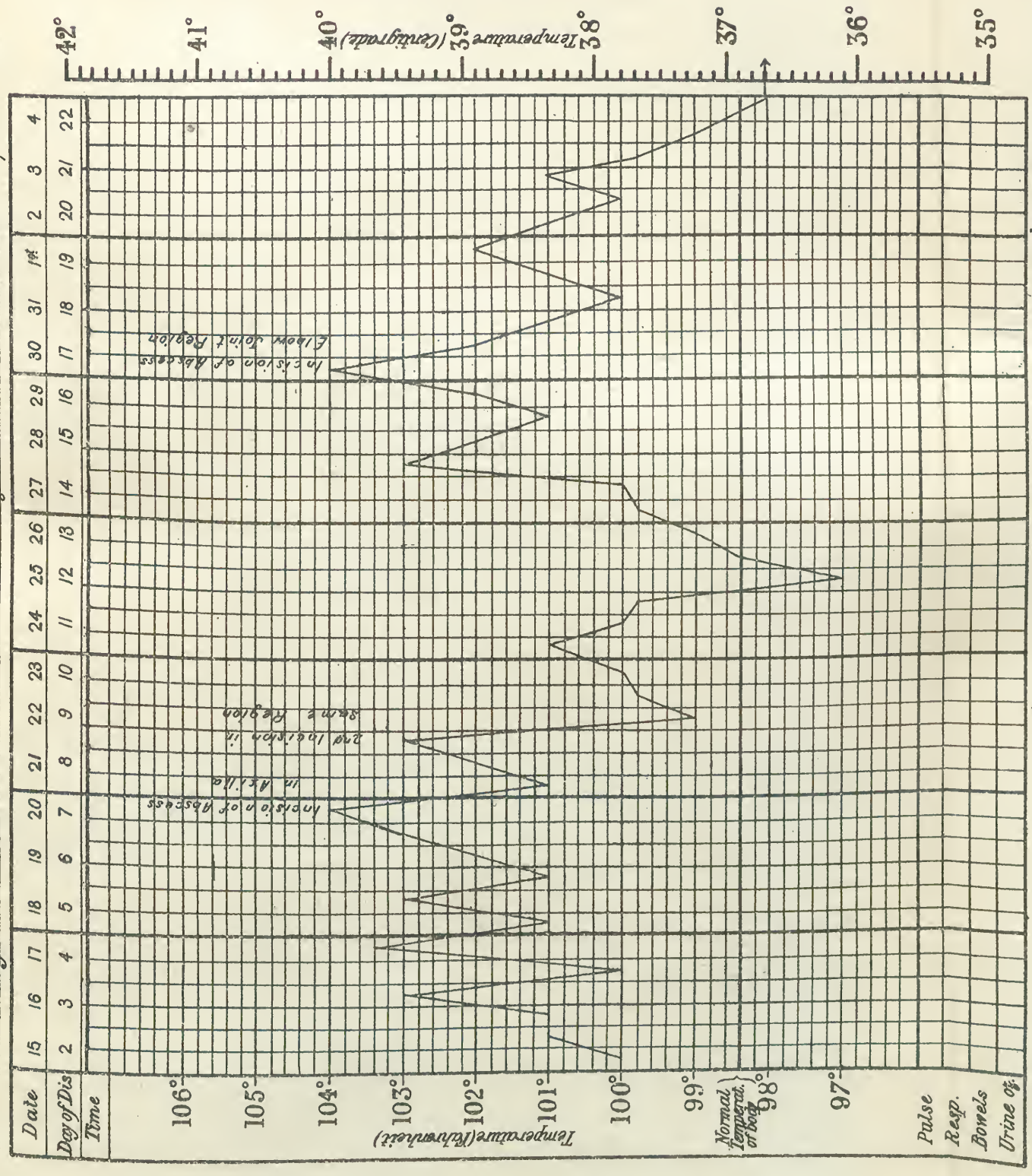
LEWIS'S FOUR-HOUR TEMPERATURE CHART.

Name Adamatu Age 4 Disease Bubonic Plague Admitted July 15 - 1924

Notes of Case.

Diet, etc.

Result Cured _____



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A small girl suffering from bubonic plague. Note Large axillary bubo and characteristic position of right leg owing to presence of femoral bubo.



An axillary bubo in an adult male at a later stage, showing a large area breaking down simulating a carbuncle.

CONTAGIOUS DISEASES HOSPITAL, KUMASI. GOLD COAST.

MORNING & EVENING.

DISEASE

Bubonic & Secondary

Pneumonic Plague

NOTES OF CASE

NAME { Zebidla Male

AGE 18 Years

DIET Milk etc

CASE BOOK No. E. I.

DATE		2.8.24		3rd		4th		5th		6th		7th		8th		9th		10th		11th		12th		13th		14th		15th		16th		17th		18th		19th		20th		21st		22nd		23rd			
DAY OF DISEASE		TIME		M		E		M		E		M		E		M		E		M		E		M		E		M		E		M		E		M		E		M		E		M		E	
R	P	T																																													
42	155	107°																																													
39	145	106°																																													
36	135	105°																																													
33	125	104°																																													
30	115	103°																																													
27	105	102°																																													
24	95	101°																																													
21	85	100°																																													
18	75	99°																																													
15	65	98°																																													
12	55	97°																																													
PULSE.																																															
RESP.																																															
BOWELS.																																															
URINE.																																															

DATE OF ADMISSION

RESULT

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The patient's temperature remained raised until the 12th day of his illness when it fell by crisis and remained about normal during the separation of sloughs and throughout the remainder of his convalescence.

In addition to the symptoms associated with the femoral bubo the following were noticed in the case of this patient and of other pneumonic cases.

Abdominal pain to commence with due to a diaphragmatic pleurisy followed by pain over both sides of the chest, cough, high fever, rapid pulse and respiration, sanguineous sputum, increasing weakness and general prostration. A broncho-pneumonic condition of the lungs was found in all such cases.

(c) The third or septicaemic type of plague occurred in 24 or 17.1% of the cases dealt with in this report.

In this type the onset of the disease appeared to be even more sudden than in the types already described.

Case No. 63, Kakraka, male, aged 24, Moshie, resident in the Zongo was seen by the writer on the 20th of July and appeared to be in good health. On the morning of the 21st of July he was admitted on suspicion to the Contagious Diseases Hospital although he professed at the time that he felt perfectly well except for a slight headache. The man died within an hour of his admission to hospital and the autopsy showed that death had been due to the septicaemic type of plague—no definite foci in glands and lungs being found but smears from lungs, spleen and heart blood all showing numerous bipolar cocco-bacilli resembling *bacillus pestis*.

This third type of plague was one of the most difficult to diagnose since local conditions were generally absent.

In persons living in plague infected areas high temperatures associated with rapid pulse and quickened respiration, congested conjunctivae and marked prostration were looked upon with suspicion and were admitted for observation to the Contagious Diseases Hospital.

In all cases death ensued within a few hours of the patient falling sick. In some of these cases autopsies revealed little abnormal apart from general congestion which usually accompanies death from hyperpyrexia.

The diagnosis was established by the examination of smears from spleen, liver, lungs, and heart's blood. In other cases well marked changes were found as described under the section on the morbid anatomical features.

(VII) MORBID ANATOMY AND PATHOLOGY.

To avoid repetition reference should be made to the facts and statistics given under the head of "Symptomatology."

It is interesting to note that in a certain number of cases of plague on examination of the body, including an examination of viscera, failed to show any naked-eye abnormality whereas undoubted proof of the cause of death was forthcoming on bacteriological examination of spleen smears, etc.

In other cases ample evidence of the presence of other diseases, for example, advanced pulmonary tuberculosis, was found, but on carrying out bacteriological tests with smears from spleen, heart's blood, etc., there could be no question of the correct diagnosis as to the cause of death being plague.

The above varieties of cases met with tend to demonstrate the necessity for the performance of bacteriological tests in all deaths occurring in persons who have not been under medical care and who reside in a country where plague is endemic.

In many instances, however, post-mortem appearances were characteristic.

Where the deceased had died of bubonic plague swellings were to be seen in one of the situations referred to under "Symptomatology." Even for several hours after death had occurred where femoral glands were involved the limb had set in rigor mortis in the semi-flexed, abducted and externally rotated position in which the deceased had held it in life time to ensure the maximum relief from pressure of the tissues on the acutely inflamed bubo.

The swellings varied in size from one to five inches and were for the most part elliptical in shape. They were tense and hard in consistency and when cut down upon were found to consist of one or more much enlarged glands of great vascularity and surrounded by a zone of sero-sanguineous infiltration. No relationship appeared to exist between the size of the bubo and the severity of a case.

The following brief description of an autopsy will serve as an illustration of a typical fatal case of plague:—

Case No. 62, Asiawu, female, aged 30, Lagosian tribe, not vaccinated, went to market on the 20th of July feeling quite well. After she had returned about 6 p.m. she complained of a headache, pains in the back and fever. She died in the early hours of the 21st of July after, apparently, less than twelve hours illness.

On examining the body of the deceased at 7.45 a.m. a few hours after her death, she was found to be a well-nourished woman about seven months gravid. Large areas of the neck and trunk were the sites of diffuse capillary haemorrhages. Buboes were absent. The conjunctivae were bright pink in colour.

On incisions being made into the subcutaneous tissue preparatory to opening the chest and abdomen the blood vessels were found to be engorged and the subcutaneous tissue appeared to be oedematous. Cloudy swelling had commenced to be apparent.

On opening the thorax the pleural cavities were found to contain about half a pint of clear straw-coloured fluid. The lungs were distinctly engorged but showed no signs of consolidation. The pericardium contained about two ounces of pericardial effusion. The heart was somewhat enlarged and fatty, the right side being dilated.

On opening the abdominal cavity which contained about half a pint of peritoneal fluid, a uterus gravid to about seven months presented. Both uterus and adnexa—particularly the ovaries—showed considerable engorgement of their vessels and extensive extravasations of blood under the peritoneal covering. The contents of the uterus proved to be a seven months male foetus in a good state of preservation. The foetus showed no signs of having been infected with plague and spleen smears were negative for bacillus pestis. The woman's liver was slightly enlarged, showed a dark mottled appearance and, on cutting into the substance, engorgement of the hepatic vessels. The spleen was almost three times its normal size, it was deeply congested and almost fluid in parts owing to extensive haemorrhagic infiltration. The kidneys were slightly enlarged, dark reddish purple in colour and dripped with blood on incision of their substance. The suprarenals were markedly engorged. Capillary haemorrhages and small petechiae were found in the submucous coat of the stomach and the whole gut particularly in and around Peyer's patches. In this case smears from the spleen, kidneys and heart's blood contained large numbers of organisms identical with plague bacilli.

It is noteworthy that smears from the bases of both lungs showed very few plague bacilli. In the absence of marked pulmonary lesions death was presumed to have resulted from septicaemic plague—the pestis siderans of certain authors.

It is a matter of interest that the foetus was not found to be infected with plague. This may be accounted for by the supposition that the death of the foetus occurred as the result of high maternal temperature in the early stage before the occurrence of septicaemia.

The day succeeding that upon which the above case died an autopsy was carried out upon the following:—

Case No. 64, Yaw Krohin, aged 36, male, Fanti.

In the above, the most characteristic signs of plague consisted of congested conjunctivæ, frothy fluid issuing from mouth and nose, marked pleurisy with effusion on both sides, areas of emphysema, consolidation and collapse scattered over both lungs. The lower lobe of the right lung was almost solid and gave the appearance on section of a cloudy solid jelly-like substance reddish-purple in colour, quite airless and cutting like liver tissue.

The lung tissue was so extensively involved as to make the observer surprised that life could have been compatible even with a much smaller involvement of tissue.

The other signs with the exception of those relating to the generative organs closely resembled those described under Case No. 62.

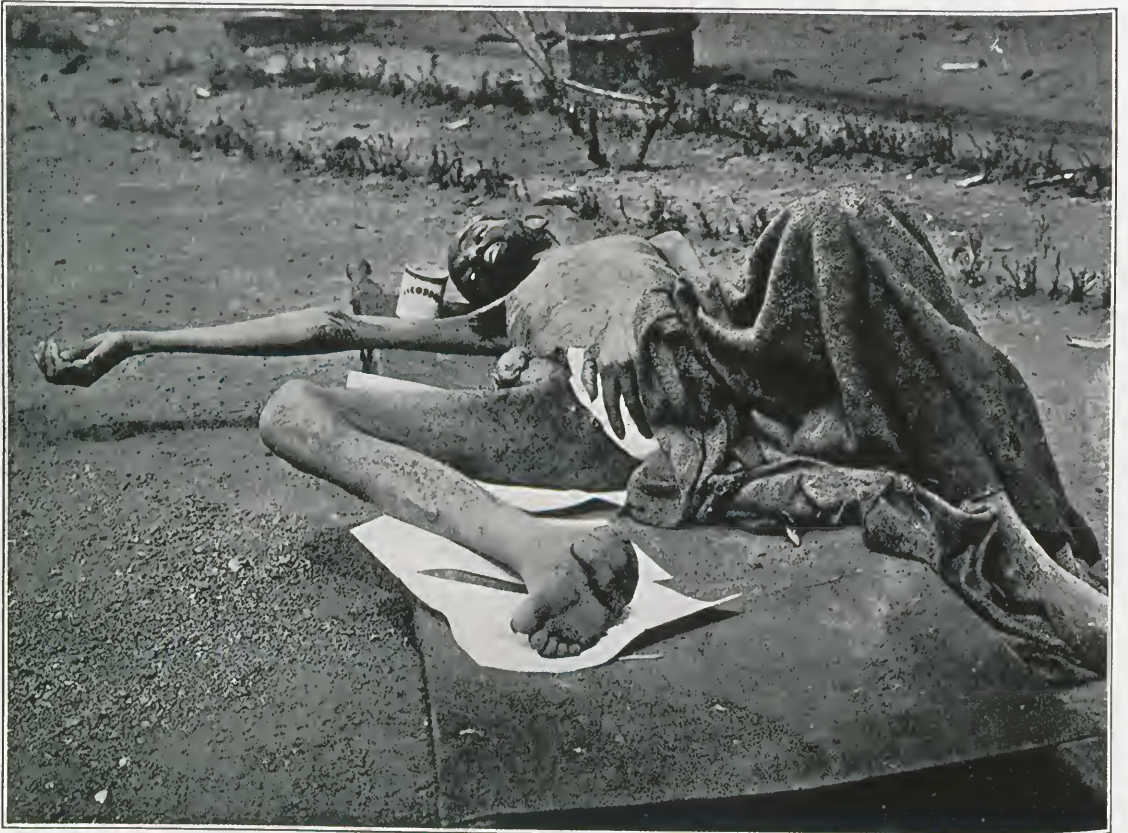
In Case No. 64, however, smears from both lungs were strongly positive for the bacillus pestis, whereas the splenic smears were negative. Smears were not taken from the other viscera. Deaths in this second case was considered to have resulted from primary pneumonic plague.

(VIII) BACTERIOLOGY.

No little difficulty was experienced in arriving at a correct diagnosis in several cases of plague owing to the degree of pleomorphism exhibited by the bacillus.

In many cases short stumpy rods from one micromillimeter to two micromillimeters in length and one micromillimeter in breadth were seen. These rods had rounded ends and exhibited marked bipolar staining when such stains as Löffler's methylene blue or dilute carbol fuchsin were used.

Instances were not infrequent in which barrel shaped coccoid forms or even pear shaped forms were seen but in these bipolar staining could often be obtained.



Reported to writer as possible case of bubonic plague. Patient was actually suffering from fungating growth in femoral group of glands secondary to primary growth in sole of foot.

In several cases many different forms of the bacillus were present in the same slide and small coccoid forms could be seen in the field with lanceolate bipolar staining rods as much to micromillimeters in length and two to three micromillimeters in breadth. Other types of involution forms were also met with.

In certain stained smears paired coccoid bacilli greatly resembling the diplococcus pneumoniae were seen and recourse had to be made to Gram's method of staining in order to arrive at a correct solution. While in other cases of doubt cultures were made and animal inoculation was carried out.

Owing to the limited laboratory facilities cultural characteristics could only be observed on nutrient agar slopes.

Room temperature being about 70° F the lack of an efficient incubator was not felt.

On nutrient agar at 70° F minute, glistening, slightly raised, circular colonies were apparent to naked eye examination after 48 hours had elapsed from the inoculation. These were shortly followed by the development of large opaque yellowish white tenacious colonies giving the impression that the culture had been contaminated.

As regards animal experiments a guinea pig was inoculated in the right thigh with about one thirtieth of a cubic centimeter of serum from the inflamed gland of a doubtful case of plague. Doubt existed as to the diagnosis owing to the atypical appearance of bacilli present in a smear from serum aspirated from the gland in question. Within 72 hours the guinea pig, which had previously been lively and which had jumped about the improvised cage on being stimulated, became motionless and apathetic and ceased to eat the grass provided for its nourishment.

On examination haemorrhagic oedema and necrosis was present at the site of inoculation, the femoral glands of the same side were much enlarged and the seat of an abscess with surrounding haemorrhagic oedema. The subcutaneous tissue over the abdomen and chest appeared to be oedematous and cloudy swelling appeared to have affected the tissues. The spleen was slightly enlarged but showed no necrotic areas. Nothing characteristic was noticed about liver or lungs. Smears from the inflamed area at the site of inoculation and from the pus and oedematous material in the region of the femoral glands contained vast numbers of typical bipolar staining cocco-bacilli identical in appearance with bacillus pestis. Smears from the spleen contained a small number of similar organisms.

In the human bubonic cases of plague from the haemorrhagic infiltration in and around the affected gland usually consisted of pure cultures of bacillus pestis but occasionally the organism was absent in such smears but was present in material obtained from splenic punctures. In other cases of bubonic plague the organism was found to be mixed with other micrococci and more rarely with pus cells. It was noted that when pus formed in a plague bubo specimens from the bubo almost always were found to be sterile both when examined as smears and when cultivated on nutrient agar.

Another guinea pig was utilised to determine whether bed bugs from an infected room were infective. The animal died two days after a bed bug had been placed upon it but showed no signs of plague post-mortem and the bed bug it was desirous of incriminating was inadvertently burnt with straw in which the animal had been kept.

In pneumonic cases on the other hand plague bacilli could usually be detected in the sputum of such patients. In cases of bubonic plague who contracted secondary pneumonic infection no difficulty was found in isolating the organism from smears from the lungs, particularly their bases.

The Deputy Director of Sanitary Services, Dr. G. J. Pirie, made a valuable suggestion that smears should be examined for the presence of the plague organism in all cases of pneumonia and broncho-pneumonia. This suggestion was acted upon with useful results.

As described under "Epidemiology" large numbers of fleas from infected houses were examined for the presence of the plague organism but without result.

(IX.) DIAGNOSIS.

The diagnosis in the majority of cases of plague met with during the outbreak was not a matter of difficulty since in pneumonic cases an examination of a smear made from sputum and stained with Löffler's methylene blue gave the typical bipolar staining cocco-bacillus. In some instances a typical organisms were found in smears stained with Löffler's methylene blue in which the organism present somewhat resembled the diplococcus pneumoniae. In such, staining by Gram's stain and cultivation cleared up the diagnosis.

Owing, however, to the fact that it was frequently possible to isolate a Gram-negative bipolar staining coccoid bacillus resembling *Bacillus pestis* from the sputum of a variety of patients who were not suffering from plague, a guarded diagnosis was always made when examining sputa and, unless clinical signs and the course of the disease suggested pneumonic plague, such patients were treated as suspected cases and with the usual precautions but were not diagnosed as suffering from pneumonic plague. As far as possible, specimens of sputum were obtained fresh since sputum when left exposed to the air for even short periods of time not infrequently became infected from the atmosphere with a saprophytic organism which greatly resembled *Bacillus pestis* both morphologically and in staining properties.

Where death had occurred complete autopsies were carried out in the early part of the outbreak, smears being taken from the lungs in confirmation of the naked eye findings. Later, autopsies were not performed partly to obviate loss of time between discovery of a case and diagnosis and consequent delay in taking appropriate action, partly to obviate the unnecessary conveying of bodies from one point to another increasing the danger of spread of infection, but chiefly owing to the very great prejudice all native races have against autopsies. In such cases where the clinical history of the deceased suggested pneumonic plague, material was aspirated from the bases and other portions of the lungs. Stained smears were made from this material and were examined. Certain cases failed to show the typical organisms, and complete autopsies had, then, to be carried out and smears again taken from infected portions of the lungs.

In deaths from septicaemic plague where there appeared to be no particular focus of infection puncture of the spleen, heart and lungs were carried out in later cases and it was usually possible to avoid complete autopsies by the discovery of the organisms in all the viscera investigated thus obviating the increased danger of discharges of infective blood in the mortuaries.

In most cases of bubonic plague the history and clinical appearance was usually so characteristic as not to necessitate an autopsy. Smears were taken of material from the buboes and if these did not provide the necessary evidence, and the patient recovered the case was not diagnosed as one of plague however clear the clinical appearance and symptoms happened to have been. In fatal cases of this type splenic puncture was resorted to and if this proved negative as regards the infecting organisms a complete autopsy was carried out and smears were taken from the incised bubo and from the other viscera.

The question of agglutination was considered in non-fatal cases clinically closely resembling bubonic plague but this method of diagnosis is so unreliable as not to be worth the trouble of carrying out.

Cultural and biological experiments in which guinea-pigs and rats were used were of assistance in establishing a definite diagnosis in certain of the doubtful cases.

It should be stated that care was taken at the commencement of the outbreak to have the diagnosis of plague made by the writer confirmed by the Director of Medical Research Institute in Accra and the opinion of this officer was sought on occasion during the course of the outbreak when doubtful cases occurred.

(X) PROGNOSIS.

The prognosis in the case of plague met with during the outbreak was dependent to a large extent on the variety of the disease. A fatal result ensued in every one of the twenty-six cases of primary pneumonic plague and in these neither age, sex, general physique, treatment, nor previous vaccination had any influence upon the fatal termination.

With one exception which has been described under "Symptomatology" all cases of secondary pneumonic plague also ended fatally.

The prognosis was equally hopeless in all twenty-four cases of septicaemic plague met with all ending fatally.

In cases of patients suffering from bubonic plague the prognosis was less grave thus differing from those mentioned above in that nineteen out of ninety cases diagnosed bacteriologically recovered and were discharged cured.

In three other cases, all of whom recovered, bubonic plague was diagnosed clinically. In view of the negative bacteriological findings these patients were treated as cases of plague and the usual action was taken in the areas from which they came but they were not returned as cases of plague. Had such been counted as cases of plague the mortality in the bubonic type would have been 76.3 instead of 78.8%.



Convalescent cases of Bubonic Plague.

Subdividing the cases of bubonic type according to the situation of the bubo the following table is given and require little explanation.

Situation of Bubo.	Total Cases.	Percentage Mortality.	Number Vaccinated.	Percentage Mortality among Vaccinated.
Femoral	69	86.9	9	33.3
Axillary	12	50.0	6	Nil
Cervical	5	80.0	4	80.0
Inguinal	2	Nil	Nil	Nil
Subclavicular and Axillary	1	100	Nil	Nil
Epitrochlear	1	Nil	1	Nil
Total	90	—	20	—

The comparatively higher mortality rate for femoral buboes as compared with cervical and axillary buboes is due to the comparatively large percentage of vaccinated persons among the latter two types.

Neglecting the three cases already referred to in whom the diagnosis was not confirmed bacteriologically, it is noteworthy that among the nineteen cases that recovered, proof of recent anti-plague vaccination was forthcoming in twelve. In three others proof of vaccination was unobtainable as the vaccinations were alleged to have been carried out early in the epidemic before counterfoil vaccination books were in use.

On the other hand, among the 121 fatal cases twenty were alleged to have been vaccinated at a date previous to the commencement of the incubation period in each particular case. Of these eleven died of primary pneumonic plague against which anti-plague vaccination appeared to have little effect, four were of the septicaemic type and six of the bubonic variety. The above data would suggest that prognosis was much more favourable in cases of bubonic plague who had been vaccinated previous to the commencement of the incubation period.

Moreover, out of the twenty deaths occurring in persons alleged to have been vaccinated prior to infection only six were cases of bubonic plague.

If, on the other hand, a vaccinated person acquired a primary pneumonic infection the vaccination appeared to have no influence on the fatal issue. The same appeared to apply to the septicaemic type of case.

Age did not appear to have much influence on the prognosis except in the very old or very young, when the disease was generally fatal.

Fatal cases occurred in an infant of four months and in an old man and old woman of 60 years. Similarly, recoveries occurred in a girl aged four years and an old woman aged 65.

It is noteworthy that the average age of male cases was 29.9 years and of female cases 28.2 years. Of fatal male cases the average age was 31.3 years and of fatal female cases 27.6 years. Of the nine males who recovered the average age was 20.11 years while the corresponding age for women who recovered was 31.5 years.

The following table requires no explanation :—

	Male.	Female.	Total.	Deaths.	Percentage Mortality.
Under 1 Year	1	1	2	2	100
1-5	2	1	3	1	33.3
5-15	12	12	24	22	91.6
15-25	14	13	27	23	85.1
25-45	34	25	59	51	86.4
45-65	10	12	22	19	86.3
65 and over	1	2	3	3	100
Total	74	66	140	121	86.4

Sex had little influence on either incidence or mortality although males were rather more affected than females.

Of the 140 cases 74 occurred in males and 66 in females and the mortality rates were 87.8 and 84.8 respectively.

The relationship of tribe to incidence and mortality was an outstanding feature of the epidemic.

The following table illustrates the bearing of tribe of the patient on prognosis without any comments being necessary.

Tribe.					No. of Cases.	Percentage of total.	No. of Deaths.	Percentage Mortality.
Northern Territory	..	..	..	..	66	47.1	51	77.2
Hausa	..	..	..	..	36	25.7	34	94.4
Lagosian	..	..	..	..	15	10.7	14	93.3
Fanti	..	..	..	..	14	10.0	13	92.8
Fulani	..	..	..	..	5	3.5	5	100.0
Ashanti	..	..	..	..	1	0.7	1	100.0
Krepi	..	..	..	..	1	0.7	1	100.0
Awuna	..	..	..	..	1	0.7	1	100.0
Sierra Leone	..	..	..	..	1	0.7	1	100.0
					140	99.8	121	—

Occupation.					Total Cases.	Deaths.	Percentage of Deaths.
1. Petty Trader	..	..	..	..	43	40	93.0
2. Married Woman	..	..	..	..	19	16	84.2
3. Labourer	..	..	..	..	17	14	82.3
4. Young Girl	..	..	..	..	11	10	90.9
5. Young Boy	..	..	..	..	10	10	100.0
6. Market Seller	..	..	..	..	8	5	6.2
7. Malam (Teacher)	..	..	..	..	5	5	100.0
8. Scholar	..	..	..	..	5	2	40.0
9. Brick Layer	..	..	..	..	4	4	100.0
10. Kola Seller	..	..	..	..	2	2	100.0
11. Cattle Dealer and Butcher	..	..	..	..	2	2	100.0
12. Barber and Hair Dresser	..	..	..	..	2	2	100.0
13. Church Keeper	..	..	..	..	2	2	100.0
14. Nursing Orderly	..	..	..	..	1	1	100.0
15. Shoemaker	..	..	..	..	1	1	100.0
16. Horse Boy	..	..	..	..	1	1	100.0
17. Cloth Seller	..	..	..	..	1	1	100.0
18. Carpenter	..	..	..	..	1	1	100.0
19. Farmer	..	..	..	..	1	1	100.0
20. Policeman	..	..	..	..	1	1	100.0
21. Prisoner	..	..	..	..	1	—	—
22. Soldier	..	..	..	..	1	—	—
23. Washerman	..	..	..	..	1	—	—
Total					140	121	—

It will be seen from the table at the top of this page that while the incidence of plague fell most heavily on the Hausas, Lagosians and members of the Northern Territory tribes the case mortality of these groups taken together was smaller than the corresponding mortality amongst the Fanti. The prognosis would, therefore, appear to have been worse as regards Fanti than any other section of the community—the numbers of Ashantis, Krepis etc. are too small to warrant any conclusions being drawn.

The higher percentage mortality among the Fanti, however, is accounted for on the following grounds.

Among the fifteen cases of plague only two were found before death. One man came up with others for anti-plague vaccination but was found to be suffering from bubonic plague. He was removed to the Contagious Diseases Hospital at once and recovered. The other girl was found to be suffering from large cervical, subclavicular and axillary buboes. She was admitted to hospital but died within 48 hours.

The remaining cases among Fanti were concealed until death occurred and consequently there was no possibility of treatment.

Occupation had little influence on the prognosis of any particular case although, as might be expected petty traders and market women stood a greater chance of becoming infected than others owing to their habit of keeping food in their houses.

The list given above gives details of occupation.



Method of conveying cases of Pneumonic Plague.

Environment undoubtedly influenced the prognosis in any particular cases since the more insanitary the premises and neighbourhood in which the patient lived the greater the danger of acquiring infection and the lesser powers of dealing with the germ after infection had occurred owing to deterioration in general health and physique and natural immunity.

A map is appended to show the distribution of cases.

From a glance at this it will be noticed that plague was most prevalent in the Zongo and Zongo Extension where housing and general sanitary conditions were worse than anywhere within the town boundaries.

Briefly, cases occurred in the following areas :—

<i>Area.</i>	<i>Total Cases.</i>	<i>Percentage of total.</i>	<i>Deaths.</i>
Zongo	75	53.5	68
Zongo Extension	48	34.2	38
Fanti New Town	7	5.0	7
Kumasi Old Town	5	3.5	5
Osofokrom	1	0.7	1
Bantama	1	0.7	1
Cantonments	1	0.7	Nil
Prison	1	0.7	Nil
C.D. Hospital	1	0.7	1

(XI). TREATMENT.

The procedure adopted in the majority of the cases of plague encountered during the epidemic was as follows.

On the discovery of a suspected case the writer at once proceeded to the area and examined the patient.

Material was obtained from buboes by means of a hypodermic syringe and, after staining with Löffler's methylene blue for one minute, was examined for the presence of bipolar staining cocco-bacilli of bacillus pestis type.

In pneumonic cases a specimen of sputum, if obtainable, was similarly treated.

Doubtful cases of bubonic or pneumonic plague were admitted to the verandah of the Contagious Diseases Hospital or to two huts set aside for suspected cases until further investigations could be made.

Except when patients were moribund when discovered all cases were removed by a special gang of sanitary labourers to the Contagious Diseases Hospital. In the early part of the epidemic a motor lorry was used to convey patients but it was found that the journey over rough roads was badly borne and consequently hand carriage on an army stretcher was found to be the better method in the absence of a well-sprung motor ambulance. The patient had a blanket wrung out in pulicide placed over his other coverings on the journey to hospital.

In pneumonic cases the four stretcher bearers had to cover their noses and mouths with cloths soaked in weak izal solution. Owing to a certain amount of discomfort arising from wearing any variety of mask during the heat of the day it was not always possible to ensure the wearing of these masks.

On the arrival at the Contagious Diseases Hospital the patient was allowed to rest for a short time to recover from the journey. Unless too ill to be moved the patient was later deprived of all clothing, sponged and dressed in a night gown in the case of a woman or in a tunic and drawers in the case of a man. As soon as possible after admission a saline purge was administered followed by one of the following (1) curative plague serum (2) intravenous iodine (3) novarsenobillon (4) purely systematic treatment.*

As regards the first method curative plague serum prepared at the Lister Institute and put up in ampoules each containing 20 c.c.s. was used in a large number of cases. The method adopted was to administer 36 c.c.s. intravenously and the same amount subcutaneously or intramuscularly. If patients survived until the following day the dose was repeated. The age of a patient was disregarded as far as dosage was concerned.

In all septicaemic and primary pneumonic cases and in all secondary pneumonic cases with one exception the effect of the serum was scarcely noticeable, all such cases ending fatally except for the one already mentioned.

*Note.—At the suggestion of Dr. Andrew Balfour, C.B., C.M.G., a trial was made towards the end of the epidemic of Mercurochrome 220. Strikingly satisfactory results were obtained in the two cases upon which a 1% solution of this drug was used.

In many of the severe bubonic cases improvement was often noticeable within twelve hours, the temperature and pulse rate falling and the patient appearing to be more comfortable and less restless.

In some of these cases, however, the temperature rose again and a fatal result ensued.

The result of serum treatment in the case of two families is instructive.

On the 1st of July a mother and her two sons were admitted to the Contagious Diseases Hospital from the Zongo Extension. All three were suffering from bubonic plague of about 2-3 days duration. Anti-plague serum was administered to the mother and her younger son aged 35 and 8 years respectively. The elder son aged 10 was treated on general symptomatic lines. The mother's temperature fell to normal on the eighth day after admission. The younger child's temperature fell to normal on the second day after admission whereas his elder brother had a raised temperature for nearly three weeks until the twentieth day after admission. Moreover, the femoral buboes of the mother and younger brother subsided within three weeks while the bubo of the elder brother suppurated requiring aspiration and, later, incision.

A similar instance is of interest.

On the 16th, 17th and 20th of July three sisters aged 4, 16, and 17 years respectively were admitted to hospital. The younger children had axillary buboes while the eldest girl had a submaxillary bubo. The elder girls were given anti-plague serum but the youngest child was treated symptomatically. The buboes of the elder girls subsided in due course without suppuration. The youngest child who had not received serum was dangerously ill for several weeks. Not only did the axillary bubo increase considerably in size and suppurate but the femoral gland on the same side became acutely inflamed and deep and extensive suppuration occurred in the region of the elbow joint of the same side.

The writer found it necessary to give the patient a general anaesthetic on two occasions in order to clear out the pus, debris and sloughs.

The recovery of the only case of secondary pneumonic plague that did not prove fatal was attributable in part to the early administration of anti-plague serum.

Judging by the experience gained during the epidemic it would appear that anti-plague serum is of no value in primary pneumonic cases, in septicaemic cases and in all severe bubonic cases unless, in the last mentioned, the serum is administered in the early days of the disease. There can be no doubt as to the value of the serum if given at the onset of an attack of bubonic plague, not only in bringing about a rapid fall of temperature but in preventing suppuration of buboes.

The second method of treatment recommended by Connor did not prove satisfactory. This consisted in giving tr. iod. mitis intravenously in doses of minims X twice on the first day and minims VII on the second and minims V on the third day.

Both pneumonic and bubonic cases were treated in this manner and in the case of the former the patient's condition was aggravated while in bubonic cases the condition of the patient remained unchanged. In view of the fact that no cases reached convalescence no opportunity occurred of treating such cases with $1\frac{1}{2}$ minims of tr. iod. mitis in aqua chloroform twice daily as recommended.

The third method of treatment with novarsenobillon was tried on the recommendation of Dr. Andrew Balfour, C.B., C.M.G., but the results obtained were not sufficiently conclusive to allow of the expression of an opinion on the efficacy of such treatment although two cases treated with 0.3. gm novarsenobillon intravenously undoubtedly showed improvement and recovered.

The fourth method of treatment which was, of course, carried out in conjunction with the three methods already described was of a purely symptomatic nature. After a preliminary purge patients were placed on a light fluid diet consisting of unlimited water, milk, bovril, orange and lime drinks etc. and were given a diaphoretic mixture consisting of Dover's powder and phenacetin and aspirin compound. This was found useful in allaying pain and restlessness and in encouraging sleep and diaphoresis.

Patients suffering from pneumonic plague or severe types of the other varieties were given a cardiac stimulant in the form of tr. digitalis, sp. ætheris nit. and liq. ammon. acetat. Brandy and water sweetened with sugar was given to all serious cases in quantities of about two ounces per diem. Hyperpyrexia, restlessness and delirium were treated by cold sponging but the administration of veronal had to be resorted to in actively maniacal cases.

Various forms of local treatment were employed. Pneumonia jackets, hot stupes and applications of tr. iod. mitis alleviated the pain in patients suffering from pneumonic plague with its frequently associated pleurisy and pericarditis. Hot fomentations, applications of tr. iod. mitis, Iodex or ichthyol and belladonna were applied to buboes.



Volunteers for Anti-plague Vaccination waiting their turn outside the Central Vaccination Station in June 1924.



As above two days before quarantine was raised. (15th. Sept. 1924)

In the majority of cases buboes were not aspirated or incised until pus was found to be present since the incision of an acutely inflamed bubo in the early stages might give rise to a septicaemic condition. When pus was found to be present—not until the end of the second week as a rule—aspiration or incision and packing was carried out. It is worthy of note that the organisms of plague were rarely found in pus which was often quite sterile.

During convalescence a plentiful diet was allowed and a tonic containing iron, quinine and strychnine was administered.

(XII) ADMINISTRATIVE PROVISIONS AND PREVENTIVE MEASURES.

(a) ANTI-PLAGUE VACCINATION.

One of the most important measures employed in the suppression of the outbreak consisted in the vaccination of the inhabitants of Kumasi and the surrounding districts and of persons coming into and passing through the town on their way to the Colony and Coast Towns southward and to the province of Ashanti and the Northern Territories to the north.

Anti-plague vaccination commenced on the 14th of June two days after the writer assumed duty as Medical Officer of Health as the result of his suspicions referred to under the heading "Origin of the outbreak."

One hundred vaccinations were carried out on that date and between the 17th of June and the 17th of September when quarantine was raised vaccinations numbered as follows:—

Vaccinations by his assistants and Medical Officer of Health	100,151
Vaccinations by Dr. W. E. Masters, Private Medical Officer	2,218
Vaccinations by Dr. P. D. Oakley, Medical Officer, Native Hospital	755
Vaccinations by Drs. F. Harper and W. M. Wade	250
Total	<u>103,374</u>

Vaccination could not be made compulsory but it appeared to be justifiable to make use of Certificates of Vaccination as permits to leave the infected area. As a result, all persons wishing to leave Kumasi reported for vaccination in order to obtain the necessary pass to leave the town. In the same way contacts with plague cases and others living in the infected part of the town were persuaded to seek vaccination as well. In the early part of the epidemic the townspeople generally were afraid of being vaccinated, many stories circulating to the effect that an attempt was being made by the new Health Officer to poison the townspeople *en masse*. The Sarikin Zongo, however, was persuaded to send batches of his subjects from the Zongo for vaccination, the Officer Commanding Troops brought his officers and men and the Commissioner of Police did likewise with the units under his control.

All this helped to convince the townspeople of the harmless character of the operation. In addition, movement away from the town was difficult without a certificate of vaccination and the system of stamping thumb prints on these certificates—a most valuable suggestion made by the Deputy Director of Sanitary Services, Dr. G. J. Pirie—to prevent the transfer of certificates both acted as incentives for persons to be vaccinated. In fact, throughout a great part of the epidemic there were more volunteers for vaccination than there was vaccine with which to do them.

Many came in from surrounding districts, and clerks and their families almost treated it as a Sunday morning's entertainment to walk to the vaccination station and to return home with their certificates. On one occasion the writer, on account of vaccine supplies being temporarily exhausted had to turn away at 5 a.m. when it was still quite dark, over 300 people who had formed up in a queue in readiness for vaccination. Again, the writer had to vaccinate as many as 586 intending passengers at the Kumasi Railway Station between 5.30 and 7.25 a.m. on one day owing to the fact that people with no intention of travelling were prepared to pay the railway fare (10d.) to the first stations along the Accra and Sekondi railway lines in order to get vaccinated. The normal number of passengers for that period of the year leaving Kumasi by the daily trains was between 175 and 250.

The maximum number of vaccinations performed on any one day was 2,722 on the 4th of July by Dr. P. A. T. Sneath and the writer who could only devote a comparatively small part of his time to vaccinations. This number was rendered possible with the limited number of syringes and needles available, by a method of sterilising the needle of 5 cc or 10 cc syringe after every vaccination by dipping the needle still fixed to the syringe into boiling olive oil—a method employed by the writer in giving anti-typhoid inoculations during the war.

Owing to the large number of vaccinations to be carried out it was found necessary to open a Central Vaccination and Road Permit Station in offices of the old Kumasi Railway Station.

These offices were opened on the 28th of June when the Deputy Director of Sanitary Services kindly placed the services of Dr. P. A. T. Sneath at the writer's disposal for anti-plague work.

Persons were arranged into three queues with the assistance of the police, preference always being given to persons living in the infected areas, and to women. Particulars as given on the specimen certificate facing this page were taken of each volunteer by a staff of temporary clerks. The filled in form was then handed to the person concerned who had to pass it to a second table where an impression of his thumb was taken on certificate and counterfoil. From this table the person had no choice but to pass into a room where his arm was washed with water and dried and thence into a second room where his arm was treated with a mixture of turpentine in spirit. He was then vaccinated, the vaccine being injected subcutaneously over the outer part of the upper arm. The site was gently massaged and the man was able to leave the premises.

Three varieties of vaccine were used in Kumasi. By far the largest quantity used came from the Lister Institute. On the whole this vaccine proved highly satisfactory although a small number of bottles had large clumps of dead organisms floating in the fluid which could not be shaken up into a comparatively speaking, homogeneous mass. This type of vaccine contained 3,000 million bacilli to each cubic centimeter. The dose given was one c.c. to adults, $\frac{3}{4}$ c.c. to young persons from 12 to 18 years, $\frac{1}{2}$ c.c. to children from six—12 years and $\frac{1}{4}$ c.c. to children under five years. It is impracticable to give two separate doses to a large number of natives since they cannot be relied upon to come again for the second dose after the correct interval.

In the case of Africans the local and general reaction was as a rule but slight and accompanied by slight fever (99.4 F) lasting at most 48 hours and associated with slight headache and a small tender swelling at the site of inoculation. No cases of tetanus or septic arms were encountered.

In Europeans the general and local reactions were a little more severe and in the early part of the epidemic when divided doses were given cases occurred in which the raised temperature persisted for three days while the induration at the site of inoculation lasted somewhat longer.

The other varieties of vaccine used were supplies received from St. Mary's Hospital and from Berne through the West African Drug Company. Small quantities of the last mentioned were used by Dr. Masters when supplies did not permit of his being issued with Government vaccine.

The vaccine prepared at St. Mary's Hospital contained 2,000 million bacilli in one cubic centimeter. Several bottles of this vaccine were found to be very cloudy with large flakes of agglutinated bacilli adhering round the sides of the bottle and defying shaking up. The worst of them—some ten in all—were discarded. On the whole the vaccine prepared at the Lister Institute is to be preferred.

During an acute shortage of vaccine fourth subcultures of a plague culture were sent to the Director of Medical Research Institute with a view to a supply of vaccine being prepared in the Colony against emergencies.

Volunteers for vaccinations continued to attend after the quarantine was raised and roads and Railway were open and new arrivals in Kumasi who have not been vaccinated will be encouraged to report for vaccination as will the general inhabitants since the immunity afforded is only said to last from three to six months.

According to Wilkinson's data the case incidence among vaccinated was 1.9 and the case mortality among vaccinated was 23.9 whereas the case incidence in uninoculated was 7.7 and the mortality 60.1.

In the outbreak under review the actual case incidence among vaccinated and unvaccinated cannot be calculated owing to the absence of sufficient data but the case incidence among vaccinated would appear to have been about one per thousand while that among unvaccinated would appear to have been about three per thousand. Both these figures are quite approximate.

As regards mortality, that among those vaccinated prior to the onset of incubation was 53.1 per cent. as compared with 89.2 per cent. amongst the unvaccinated. The first figure would appear to be somewhat disappointing until it is realised that it was dependent on the fact that the fatal cases among vaccinated occurred in those who acquired primary pneumonic infection.

It is probable that by far the larger proportion of the inhabitants of Kumasi have now been vaccinated against plague. The population is calculated by various authorities as between 25,000 and 30,000.



A Plague infected Compound. The occupants were eventually removed to contact camp.
The premises were demolished.



Another Plague infected compound. In the foreground a collection of refuse, old mats
etc. removed from the compound preparatory to being burnt.



A portion of a temporary camp to house persons who had been evacuated from insanitary premises in an infected area.



A portion of a second temporary camp erected on the recommendation of Sir William Simpson to house persons evacuated from a badly infected area.

Probably between five and ten per centum of the 103,374 vaccinated in the three months were re-vaccinations since applications were made on many occasions for re-vaccination and when stocks of vaccine were not too small the requests were granted.

In the early part of the outbreak vaccine was reserved for persons over five years of age but this age limit had to be reduced when fatal cases were met with in still younger children.

Taking all this into consideration there is little doubt but that over 90,000 primary vaccinations were performed during the three months.

This number is at least three times greater than the estimated population of Kumasi. The surplus is accounted for partly by the large numbers of vaccinations carried out on the inhabitants of surrounding villages who came in for vaccination passes in order to be able to return past the police barrier. The remainder of the surplus can be accounted for by the large floating population in Kumasi which is a trade centre and railhead for the Colony, the province of Ashanti and the Northern Territories.

Information regarding the daily influx and exodus of people into and out of Kumasi is given under "Police Posts."

(b) ISOLATION OF CASES AND CONTACTS.

At the commencement of the outbreak under review the accommodation at the Contagious Diseases Hospital consisted of two small wards in a concrete block building capable of accommodating at most ten patients.

In addition, there were kitchens, quarters for the Caretaker and his wife, a latrine and store room.

Apart from these the Deputy Director of Sanitary Services had had erected during the earlier outbreak of plague in Kumasi in April and May two large corrugated iron huts in a corner of the compound together with kitchen and latrines to provide accommodation for some thirty contacts.

Needless to say, this accommodation proved entirely inadequate for as many as twenty two patients suffering from plague—some of the pneumonic type who could not be nursed in the same wards as those of the less serious types—were in hospital at one time with suspected cases with pneumonic and broncho-pneumonic symptoms and other suspected cases with inflamed buboes and pyrexia.

Permission was obtained during the later stages of the epidemic to erect further accommodation. For the sake of brevity a plan of the original accommodation available is appended including the two huts erected in May to house contacts by order of Dr. Pirie. The accommodation finally provided towards the end of the epidemic is shown in red.

But for the foresight shown by Dr. Pirie in having the two contacts huts erected in May the hospital would have been even more overcrowded than it actually was. These huts were used for housing the 42 contacts from the first two infected houses and after the discharge of those contacts the accommodation became available for actual and suspected cases of plague.

The following routine procedure was carried out when cases of plague or deaths from the disease were reported.

- (1) A police guard was immediately placed over the premises.
- (2) The writer proceeded to the house and made a superficial examination of the patient or body of the deceased.
- (3) In suspicious cases the patient with one outer covering soaked in dilute izal was removed to the Contagious Diseases Hospital, in the early days by lorry but latterly on a stretcher by a special squad since patients were found to suffer from the lorry travelling over rough ground.
- (4) On admission to hospital bacteriological tests were carried out and, on the findings together with clinical observations, the patient was placed in one of the various wards or huts. Here, if his condition permitted, he had his clothes taken away from him, and he was washed and issued with hospital kit. The clothes taken away were disinfected in a "Sack Disinfector," washed, dried, and placed in a store. If the patient recovered he was re-issued with his clothing after bathing in disinfectant on his discharge. In fatal cases most of the patient's clothes were buried with him, the whole being surrounded by his fouled blanket and saturated with five per cent. izal before being placed on a lorry and taken to the burial ground. Coffins were dispensed with in most cases since the majority who died were of the Mohammedan faith. Personal belongings of the deceased were disinfected and handed over to the Sarikin Zongo for distribution or were handed to the relatives of the deceased.

(5) In fatal cases occurring in houses the body was covered in his bedding soaked in five per cent. izal and was brought on a stretcher by a specially protected squad to a small area of ground barricaded off for the purpose at the Health Office. In the early days of the outbreak the bodies of deceased were carried by their relatives to the mortuary but this practice was stopped owing to the danger of the spread of infection to the bearers.

On the arrival of the body at the Health Office the contents of buboes, if any, were examined together with smears from splenic punctures, and from punctures of the lungs and heart. In the event of negative results being obtained the body was conveyed to the mortuary and a complete examination was carried out care being taken in cases of plague to disinfect the mortuary thoroughly on the completion of the autopsy.

(6) In all definite fatal and non-fatal cases of plague and in all suspicious cases the infected house was sealed and disinfected, *vide* "Disinfection." In the first cases contacts were removed to the two contacts huts at the Contagious Diseases Hospital but in most of the subsequent cases until adequate accommodation was provided, these were allowed to return to their houses. They had their clothing disinfected and were examined by the writer every day, for ten days—later twelve days. All those not vaccinated were vaccinated. In suspicious cases which were not confirmed the contacts were allowed to proceed to work after being medically examined early each morning.

In all 1,434 contacts with actual cases of plague were kept under surveillance and 39 or 2.7 % of these contracted the disease.

The maximum number of contacts in a single compound house was 69 and the minimum three. The average number per house was twenty-five. At one period of the outbreak seventeen compound houses were under police guard and as many as 425 contacts were being examined every day.

Later in the epidemic when accommodation for contacts had been provided 158 were under daily observation at one time. While confined contacts were supplied with sanitary labourers who carried water, removed house refuse and nightsoil and went on errands to the market to effect purchases of food for the house inmates.

At the end of their period of surveillance—provided no further cases had occurred on the premises—the contacts had their clothing disinfected and were instructed to report at once if any fell sick and were given instruction on general sanitation. In order to escape surveillance and disinfection of their premises instances occurred where plague stricken persons were carried to houses remote from the house in which they had fallen sick. In other instances sick were carried to the bush and left to die and in still further cases dead bodies were carried from one house to another and even dumped outside an incinerator. In all such—which led to prosecution—the number of contacts was increased owing to the necessity of keeping more than one household under surveillance.

Patients who were isolated at the Contagious Diseases Hospital and who recovered were kept in hospital for an average of 42.2 days in the case of males and 41.5 days in the case of females.

The segregation of indirect contacts from houses situated in a badly infected area was carried out in a temporary camp brought into being at the recommendation of Sir William Simpson. Indirect contacts to the number of 106 were segregated in this camp. All the houses in the badly infected section from which they came were demolished and after a period of surveillance lasting twelve days the indirect contacts were given accommodation in a second temporary camp until such a time as the construction of the houses in the new Zongo will have been completed.

(c) DISINFECTION.

When suspected cases of plague occurred endeavours were made as far as possible to close the premises before any articles had been removed elsewhere.

This was not always possible since in the early part of the outbreak it was found that, contrary to instructions that were broadcast through the District Commissioner at his meetings with the Chiefs and through the Sanitary staff engaged on house to house inspection, many persons repeatedly took clothing, mats and other flea-and-bug favoured material from premises in the town in order to avoid possible detention and disinfection.



Fumigation of infected premises with Motor Claytons. (Sulphur di oxide).



Fumigation of railway truck containing rat- and flea-favoured merchandise. (Liston's Cyanide Fumigator).

Premises were disinfected after having been sealed in most cases with paper and cocoa bags but in some cases with large tarpaulin sheets and even with grass and leaves where the demand for the usual material exceeded the supply as when cases occurred in several areas at the same time.

Simultaneously, all surrounding premises were also sealed in order to obviate the possibility of plague infected rats escaping from the infected premises to neighbouring houses. Various methods of disinfection were employed according to the type of the premises.

In the usual type of mud and wattle poorer class native house disinfection with sulphur di oxide was used. As far as possible the actual infected premises were disinfected with the motor type Clayton Disinfector, the surrounding premises being disinfected with burning sulphur in pans. In the Clayton Disinfector the percentage of sulphur di oxide in the atmosphere could be regulated whereas this was not possible in the case of the pan method when 2-3 lbs. of sulphur were burnt for every thousand cubic feet of air space. In the absence of an adequate number of Clayton Disinfectors, however, the unsatisfactory pan method had to be, perforce, employed.

A total of 560 houses consisting of 6,815 rooms were disinfected by sulphur di oxide.

This number includes every room of every house in the Zongo and Zongo Extension where over 87% of the total number of cases occurred. In many instances houses were disinfected on several occasions.

In stores and the better type of house built in concrete blocks Glen Liston's Cyanide Fumigator which the Medical and Sanitary Advisory Committee of the Colonial Office were kind enough to allow the writer to bring out at the end of May was used. This was found to be by far the most effective method of disinfection especially in stores containing flour, sugar, cocoa, rice, and other foodstuffs that would have been spoilt by the use of sulphur di oxide.

This apparatus was found to be of great value also in hospital wards and theatres, and in barracks since the premises could be thoroughly disinfected and yet rendered quite safe for occupation in a minimum period—a matter of considerable importance in such places as the Native Hospital, where the use of sulphur di oxide would have prevented use being made of the premises for many hours.

The apparatus was invaluable in the disinfection of trucks of rat-and flea-favoured merchandise, *e.g.*, cotton in bales, sugar, rice, cocoa, and bags. Owing to only one apparatus being available and since Sekondi was an infected place from plague when operations on trucks were commenced, only merchandise consigned to Accra was disinfected. In view of the fact however, that consignments of kola were sent to Sekondi mostly for transport to Nigerian ports and that it was packed in the infected area, the Liston Fumigator was also used to disinfect kola.

Upwards of 800,000 cubic feet were disinfected with this apparatus during the period 17th June to 17th September.

Carefully used under the supervision of a medical officer, the writer is confident that the cyanide method, as devised by Liston,—as apart from the dangerous dumping method in vogue in the United States, in France and elsewhere—is quite safe and is the most efficient method yet devised of disinfecting dwelling houses, stores, hospitals, railway trucks, etc.

In actual practice one kilogramme of concentrated sulphuric acid diluted to a 50% solution and one kilogramme of sodium cyanide made into a solution to two litres with water was used for every 10,000 cubic feet of air space. In single trucks of a standard capacity of 1,540 cubic feet a proportionately smaller amount was used. Half an hour after the apparatus had been started and the hydrocyanic gas evolved tests made usually showed that the percentage of gas passing through the outlet tube was between 100—140 parts per 100,000. (An exposure of half an hour to 20 parts per 100,000 is sufficient to kill rats and of 25 parts per 100,000 to kill monkeys)

No one was allowed to enter premises until the test showed that the parts of gas per 100,000 had fallen below 20 and then only after the writer had himself tested the atmosphere by walking through the building or truck.

Other minor methods of disinfection consisted of:—

(1) The "Sack" Disinfector which was installed at the Contagious Diseases Hospital and used for disinfecting clothing and blankets of patients, suspects, contacts, nursing orderlies and ward boys.

(2) The Mackenzie Sprayer employed on premises in infected areas using a solution of 5% izal and a pulicide consisting of kerosene, liquid soap and water in the proportions recommended by Purdy of Sydney.

(3) Izal solution of 3% strength in large barrels in which contacts under surveillance soaked their clothing for 12 hours. A somewhat stronger solution was used for disinfecting the discharges of plague patients, excreta, sputa and vomit.

(4) Large quantities of the pulicide mixture recommended by Purdy of Sydney were issued gratis in quantities of one half a cigarette tin-full to inhabitants of the Zongo and Zongo Extension from barrels kept outside the Sarikin Zongo's house: Instructions were given for persons to use this on their bodies when washing.

(5) Disinfection by fire was carried out in the Zongo and Zongo Extension on the 29th of June when the inhabitants were persuaded to demolish the thatched roofs over 324 rooms in the infected areas and to burn same in the interior of their rooms.—Dressings from plague patients were invariably burnt.

(6) Disinfection by sun and fresh air was aimed at when the inhabitants of Kumasi as a whole, though more particularly those living in the Zongo and Zongo Extension, were persuaded to make two windows to each room of every house, shop, or store to remove enclosed, subdivided and overhanging verandahs, and to demolish buildings in the compounds of their yards obstructing light and air.

(d) QUARANTINE POLICE MEASURES.

Although the first case of plague was definitely diagnosed by the writer on the 17th of June and was reported by telegram on the 18th of June and three further fatal cases occurred on the 18th and were reported on the 19th of June—all being confirmed by the Director of Medical Research Institute in Accra to whom smears were sent—Kumasi was not declared an infected place until ten days later when Order by the Governor No. 2 of 1924 was made. Moreover, owing to a misunderstanding Regulation No. 12 of 1921 made under the Infectious Diseases Ordinance of 1908 (Chapter 61, Laws of the Colony) was not officially made applicable to Kumasi until the 6th of August when the regulation was applied by Order No. 7 of 1924 dated 6th August, 1924.

In spite of this however, and to protect the inhabitants of the ports and outstations from infection and to protect Kumasi from re-infection from the surrounding districts and outstations in the event of cases of plague escaping from the town, the writer deemed it advisable to take action as though Kumasi had been declared an infected place from the 18th of June and as though Regulation No. 12 of 1921 had been made applicable from the same date.

On the 20th of June on receipt of a telegram from the Director of the Medical Research Institute, Accra, confirming the diagnosis of plague from the smears sent to him, steps were taken to notify the townspeople that on and after the 21st of June intending passengers by train to Accra, Sekondi and outstations would be medically examined before being allowed to board trains and that all such passengers should attend medical examination one hour before the departure of each train. To enforce this a police guard was established at the station and with the exception of five days, the writer attended from 5.30 a.m. daily from the 21st of June to the 17th of September to medically examine and vaccinate all unvaccinated intending passengers by train from Kumasi to the ports and outstations. As many as 506 examinations, and vaccinations were carried out on one morning for the two trains necessitating a slight delay in the starting of the trains. The average number of persons dealt with was about 200 per day over the whole period and as the percentage of vaccinations among the general population increased so vaccinations—as apart from medical examinations—fell until only 26 vaccinations were carried out at the Railway Station on the day prior to Quarantine being raised on the 17th of September.

Altogether nearly 15,000 intending passengers were dealt with at the Railway Station although not quite all of these left by train since a number of suspects were detained and a number of persons came for vaccination presenting themselves at the barrier as bona fide passengers but with no intention of leaving by train.

The police guard at the Railway Station was also used in connection with the examination of passengers arriving from Sekondi during the period of quarantine of that port. The number of such passengers examined on arrival by the Sekondi train and for ten days following the date of arrival was 120.



A Quarantine Police Barrier on the Juaso Road. No persons were allowed to leave Kumasi by such roads unless they were in possession of a certificate of vaccination bearing an imprint of their left thumb.

72236

CERTIFICATE OF PLAGUE VACCINATION.

Name... PRIMA

Ago... 38

Sex... MALE

Tribe... DAGOMBA

Residence... KUMASI

Date of Vaccination... 27. VIII. 24 192 .

Govt. Press, Accra.—408 Bkz.—84/2/24



P. S. Schuyler

Medical Officer of Health.



A type of plague infected compound. Rats and mice were found to nest in the thatched roofs and such buildings were almost impossible to disinfect efficiently. On Sunday, 29th of June, occupiers of such dwellings were persuaded to burn the roofs inside their rooms.



After the thatched roofs had been burnt by their occupants the buildings were demolished in many cases as the rooms were often only 6 ft. by 4 ft. by 5 ft. in size and were unprovided with either lighting or ventilation.



Medical Inspection and Anti-Plague Vaccination of all passengers leaving Kumasi by Train for the Ports and Outstations.

QUARANTINE NOTICE.

All passengers, whether in possession of medical permits or not, **MUST** present themselves to the Medical Officer of Health at the Railway Station before boarding trains.

P. S. SELWYN-CLARKE.

Medical Officer of Health.

Other police guards were established on the 28th of June—the day following the actual declaration of Kumasi as an infected place. Prior to this, notices were posted up over the town notifying persons wishing to leave Kumasi by road on and after the 25th June to present themselves for road permits at the Central Vaccination Station established at the Old Railway Station.

Permits to leave the area were issued in the form of certificates of plague vaccination—vaccination being rendered more popular thereby. In order to prevent the sale, exchange or theft of passes a system of thumb prints on the permit form was established. This was the able suggestion made by Dr. G. J. Pirie, Deputy Director of Sanitary Services. On the 28th of June police posts were established on the two main roads leading south and to the ports and on the Accra and Sekondi railway lines about $1\frac{1}{2}$ miles from the town. As additional reinforcements of police arrived in Kumasi and further supplies of anti-plague vaccine became available additional police posts were established. Immediately prior to quarantine being raised the road police posts numbered eleven, six functioning day and night and the remaining five from 4.30 a.m. to 8.30 p.m.

Some idea of the number of persons entering and leaving Kumasi daily by road—as apart from by train—during a period of quarantine and in a quiet trade period preceding the commencement of the cocoa season can be seen by a glance at the table given below. The census was taken on three occasions by literate police at the police posts and the numbers were certified by the Assistant Commissioner of Police.

Date of third census 15th September, 1924—from 5 a.m. to 8 p.m.

<i>Situation of post.</i>	<i>Number of persons entering Kumasi.</i>	<i>Number of persons Leaving Kumasi.</i>
Kutanassie Road and Sekondi Line jct.	1,164	1,062
Bantama and Nkawe Road jct.	935	1,084
Kintampo Road north of New Cemetery	918	904
Accra Railway Line east of Zongo	825	706
Patasi Road	846	923
Antwa Road at Mohammedan Cemetery . . .	633	570
Offinsu Rd. 100 yds. north of jct. with Kintampo Road	554	623
Bekwai Rd. south of Colonial Bank Bungalow ..	549	510
Juaso Rd. at jct. of Old and New Ejissu Rd. ..	467	426
New Lake Rd. south east of New Asafo	332	156
Residency Rd. south end of Residency	255	230
Total	7,478	7,194

In addition to the police posts, picquets of the Gold Coast Regiment were stationed on all roads of approach to the Zongo, Zongo Extension and to Bantama when a case of plague occurred in this township. These picquets had orders to prevent any soldier from passing into the infected areas.

It was considered advisable, however, in spite of these precautionary measures, to prohibit for the time being the movement of troops to Kintampo or other stations in order to protect such areas from infection.

Other legal measures in connection with quarantine conditions included the prosecution of persons failing to report cases of plague, of persons failing to report deaths from plague, of persons guilty of both the foregoing and aggravating the offence by depositing the body of a

man dead of plague outside a public incinerator, of persons attempting to evade medical examination by boarding trains without first submitting to examination, by persons presenting passes for visé at the Railway Station and police barriers, such passes having been issued to a second party and having the impression of the thumb of the second party on them.

Reference is made to legal measures taken for general sanitary offences under the heading "General Sanitary Measures."

A list of persons punished for offences against quarantine regulations is appended.

(e) RAT DESTRUCTION.

The hunting and trapping of rats formed an important part of anti-plague measures for not only was the actual destruction of rats essential but the examination of rats gave valuable information as to the areas in which cases of plague were likely to occur.

Kumasi was somewhat unfortunately situated as regards its rat population at the commencement of the outbreak for there were large accumulations of damp refuse around the majority of the incinerators and these together with large heaps of tins and other indestructible refuse afforded excellent conditions for attracting rats and for their breeding. In the same way the wide areas of bush in open spaces and on the outskirts of the various districts of the town into which large amounts of refuse had been thrown, afforded ample food and protection for rats. Such areas were cleared and refuse round incinerators and elsewhere was burnt.

As far as possible rats were captured alive but if found dead were placed in tins and brought to the office for examination. The use of poison and break back traps was avoided owing to the danger of infected fleas leaving the bodies of dead rats.

Moreover, owing to large numbers of domestic animals in and around houses the use of such poisons as arsenic, phosphorus or strychnine was contraindicated. Barium carbonate or squill might have been used but the writer carried out experiments with these in Accra in 1921 and found them to be of no value.

For the same reason no attempt was made to use the Dany's Virus which loses its potency rapidly under tropical conditions and which, when efficient, is a dangerous method to employ in plague outbreaks when it is desirable to catch rats alive with the infected fleas on them.

The Rodier method was not given a trial for the only good rat was thought to be a dead rat.

A rat gang of one headman and twenty men, later reduced to one headman and nine men, was employed during the outbreak. Circulars were sent to all Europeans regarding rat destruction and rat-proofing of premises. The District Commissioner was also asked to have gong-gong beaten to inform the Chiefs as to what action should be taken. Headmasters of schools were also circularised and asked to organise small bands of school children for rat hunts and for the clearing of possible nesting and feeding places. Notices were posted in various parts of the town offering 2d. for every rat brought to the office but the schools and general population were somewhat apathetic and only £6 12s. 10d. was paid out for 797 rats during the period 17th June to 17th September. To ensure further publicity for an anti-rat campaign the writer had notices whitewashed over public latrines and private dwellings with the words "KILL RATS AND STOP PLAGUE" or the native equivalent painted thereon.

General household and municipal cleanliness was insisted upon as far as possible and action was taken against householders who failed to fill up rat holes on their premises or failed to concrete floors etc. Storekeepers were served with notices to render their stores rat-proof and action was taken in cases of default.

As regards the actual method of trapping rats, by far the most successful method consisted in the use of a quantity of lithographic varnish brought out at the end of May by the writer with the kind sanction of the Medical and Sanitary Advisory Committee of the Colonial Office.

The varnish was smeared over sheets of strong brown paper about 24 square inches and to the depth of about $\frac{1}{4}$ of an inch. In the centre of this trap a piece of bait was placed but the odour of the varnish was found in itself to attract rats and mice. The traps were placed along walls and covered with buckets and boxes. As many as seven rats have been caught on such a trap at one time. The supply of this varnish soon became exhausted, unfortunately, but not before large numbers of rats had been caught through the medium of it. A further advantage of such a trap lies in the fact that if fleas attempted to leave the rat they were caught in the varnish.



Anti-Rat Propaganda. The photograph illustrates also the manner in which night-soil and water for Europeans was carried in uncovered tins through the streets of the town. Both methods have been remedied.



Anti-Rat Propaganda.



Anti-Rat Propaganda.



Mr. F. W. Abbott, Laboratory Assistant, examining Rats brought to the Health Office. Note Two Guinea-Pigs to left of Photograph. Many of these were used in biological tests and as a Plague index.

The usual method employed for trapping consisted of wire cage traps baited variously with fish heads, dough, banana and kenki.

Dipping traps after use in boiling water, smoking them, and smearing them with citronella was employed when rats appeared to become trap-shy owing, possibly, to the odour from the trapper's hands.

An average of 200 traps were set daily all over the town area for the three months of the outbreak. Thus, there were about 18,600 traps set during the period and these resulted in the capture of 4,939 rats.

Other methods employed in killing rats consisted in the fumigation of premises with Liston's Fumigator and with the Clayton Disinfector. With the latter, several rat holes in rat-ridden premises were filling with sacking and the inlet tube delivering sulphur di oxide gas from the Clayton was placed in a hole left open—rats and fleas being killed in the burrows at the same time.

Owing to lack of staff no enumeration and examination of rats for the presence of the plague bacillus was possible until the 23rd of June when the services of Mr. F. W. Abbott, Laboratory Assistant, were made available. From that date until the 17th of September when quarantine was raised 4,939 rats were brought to the office for examination and 266 or 5.3% of the rats were found to be infected with plague like organisms. Particulars regarding species trapped are given under heading of "Epidemiology."

The routine examination of rats was found to be of great assistance since attention was drawn to possibly dangerous premises and areas and necessary action could then be taken.

Mangy and diseased dogs to the number of 208 were painlessly killed with prussic acid gas owing to the possible danger of these animals having fleas which could serve as carriers of plague. Out of the 208 dogs killed 28 were examined but were found to be free from plague infection.

Many diseased cats were similarly treated and two were examined but were found to be negative.

(f) INCREASE OF STAFF.

Apart from the Medical Officer of Health, at the commencement of the outbreak the sanitary staff in Kumasi consisted of the following :—

- (1) One Superintending Sanitary Inspector.
A second " " " sent to take over from (1) to allow (1) to proceed to Accra.
- (2) One 1st Division African Sanitary Inspector.
- (3) Six 2nd " " " Inspectors.
- (4) One Office Clerk.
- (5) One Contagious Diseases Hospital Caretaker.
- (6) One Assistant Disinfector Mechanic.
- (7) One Assistant Public Vaccinator.
- (8) One Sexton.
- (9) One Storekeeper and Clerk to Deputy Registrar of Births and Deaths.

Needless to say, the above staff was entirely inadequate to deal with a town of the area of Kumasi with such a large population. Each 2nd Division African Sanitary Inspector had between 4,000 and 5,000 inhabitants to take care of apart altogether from their duties in connection with roads, streets, drains, open spaces, latrines, incinerators and bathing places.

The inadequacy of the staff was no doubt due to the fact that the total number of sanitary officers available in the Colony was far below the number actually required. The Deputy Director of Sanitary Services sent up the following additional staff.

- (1) Mr. F. W. Abbott, Laboratory Assistant, 22/6/24 for the examination of rats, etc.
- (2) Mr. F. I. Rees, Superintending Sanitary Inspector, 1/8/24. This officer was in hospital from 9th August to 3rd September.
- (3) Mr. W. Gilling, Superintending Sanitary Inspector, 8/8/24. This officer was sick in quarters for a short period.
- (4) 1st Division Sanitary Inspector, Mr. H. A. Boateng 14/7/24 to take the place of 1st Division Sanitary Inspector Mr. R. C. Jackson who proceeded to Accra on 17/7/24.
- (5) 2nd Division African Sanitary Inspector Mr. F. R. C. Nartey 14/7/24 to carry out certain important works required by the writer in connection with additional temporary latrine accommodation.

(6) 1st Division African Sanitary Inspector Mr. A. E. Bentil, 8/8/24, to assist in disinfection.

(7) Four partially trained temporary Sanitary Inspectors, 24/6/24 two to carry out work in connection with thumb prints at Central Vaccination and two to assist in disinfection.

(8) Further four partially trained Sanitary Inspectors 2/7/24, to assist in disinfections.

(9) Through the kind offices of Dr. W. M. Wade, Acting Assistant Director Medical Services, a volunteer nursing orderly was obtained to nurse the plague patients and suspects at the Contagious Diseases Hospital since the caretaker's knowledge of nursing did not extend to reading a clinical thermometer.

This volunteer contracted pneumonic plague from a patient and it is much regretted that he died. A second volunteer was obtained later, in the outbreak, also through the kindness of Dr. Wade, and this nursing orderly is still on duty at the time of writing.

(10) The Director of Medical and Sanitary Services, Dr. W. E. O'Dea very kindly lent the services of the following Medical Officers having in some cases, to close other stations to do so.

Dr. P. A. T. Sneath	.. from 28/6/24 to 28/7/24.
Dr. E. S. Mack ..	.. ,, 28/7/24 ,, 20/9/24.
Dr. W. M. Howells	.. ,, 8/8/24 ,,
Dr. G. F. Saunders	.. ,, 20/8/24 ,, 13/9/24.

For the space of nearly three weeks the writer had the valuable assistance of three Medical Officers at the same time owing to the generosity of Dr. M. E. O'Dea.

(g) EDUCATIONAL PROPAGANDA.

This was made use of in various ways. Circulars regarding the value of anti-plague vaccination and other sanitary measures were sent to all Europeans in Kumasi. The President and members of the Chamber of Commerce were asked to assist in spreading these views amongst their African staff and the population generally, and this they kindly carried out.

Dr. M. E. Masters kindly gave a lecture on plague to all English-speaking persons in Kumasi.

(h) MISCELLANEOUS MEASURES.

(1) Closure of schools. Owing to the prevalence of septicaemic and pneumonic plague, more especially in the area in which the schools were situated, it was thought advisable to close all schools in Kumasi. When the town had been free from fresh cases of plague for ten days from the 5th of September they were allowed to re-open but with reduced numbers in every class room where there was a danger of overcrowding. Careful instructions were given to the headmasters to report any cases of sickness or absence due to sickness among their pupils and to take special measures with regard to the daily-washing and disinfection of their schools.

(2) Closure of Cinema. For the same reasons as in the case of schools the Cinema was kept closed—six deaths from plague occurred within a short distance of the building. The Cinema was allowed to re-open on the 17th of September arrangements having been made to have the building sprayed out with a two per cent. solution of izar before and after every performance.

(3) Churches were not closed owing to the fact that all were very well ventilated indeed and that no overcrowding took place. Moreover, it was thought that the clergy of various denominations could greatly assist the Health Authorities by preaching sermons on anti-plague and general sanitary measures. This was done with fair results in some cases.

(4) On the recommendation of Sir William Simpson, a sexton was appointed to control the new Mohammedan Cemetery the object being to keep a check on and to prevent unauthorised burials.

(5) A small house was erected for this sexton and for the sexton in charge of the Government Cemetery at the Cemeteries to ensure the presence of these officers at all times.

(6) Legal measures relating to the outbreak were based upon the following :—

Infectious Diseases Ordinance (Chapter 61, Laws of the Colony), Ashanti Order by the Governor No. 1 dated 27/6/24 declaring Kumasi an infected place for plague revoked by Order by the Governor No. 7 of 1924, dated the 17th of September, 1924.

Order by the Governor No. 20 dated 2/7/24 declaring Sekondi an infected place owing to an outbreak of plague revoked by Order by the Governor No. 23 dated 25/7/24.



A malarious swamp situated within the confines of Kumasi. This is being drained and filled in to form a public park.



Another swamp at present being filled-in.



The swamp referred to opposite after being partially filled in. X=premises similarly marked on opposite page.



The swamp referred to on opposite page after being filled in. Note temporary sheds erected on filled in area. These form portion of New Market.

Order by the Governor No. 7 dated 6/8/24 applying Regulation No. 12 of 1921 to Kumasi.

Ashanti Administration Ordinance No. 1 of 1902.

(The Rules with respect to Registration of Births and Deaths are obsolete and recommendations were made for the Births, Deaths and Burial Ordinance—Chapter 55, Law of the Colony—to be applied with certain modifications. Sir William Simpson was strongly of the opinion that the existing machinery and registration forms in Kumasi were unsatisfactory.)

(7) The District Commissioner was asked to have gong-gong beaten and to bring to the notice of the Chiefs of Kumasi the contents of the following :—

No. 147/53/1924.

Sanitary Dept.,
Kumasi.

19th June, 1924.

MEMORANDUM.

PLAGUE IN KUMASI.

I should be grateful if you would be so good as to have gong-gong beaten again instructing the Chiefs, particularly those in the various divisions of the Zongo.

- (1) To have a special clean up. One or two of the Zongo Chiefs have made a half hearted attempt to clear their areas as the result of your previous instructions.
- (2) To send their people to this office for anti-plague vaccination.
- (3) To send their sick to the Native Hospital.
- (4) To report all deaths immediately to this office.
- (5) To bring rats—dead or alive—to this office. These rats should be brought in kerosene tins which will be returned to their owners and the sum of 2d. will be paid for every rat received.
- (6) To make louvered windows in their houses—at least two to every room and four feet six inches by three feet in size. Otherwise it may be found necessary to demolish the houses as has been done in Old Asafo.
- (7) To place their bedding and mats in the sun every day in order to kill fleas, bedbugs and other carriers of disease.

P. S. SELWYN-CLARKE,

Medical Officer of Health.

THE DISTRICT COMMISSIONER,
KUMASI.

(8) Owing to the danger of the dissemination of infection resulting from the congregation of large numbers of people, the holding of funeral customs and other native gatherings was prohibited during the outbreak in Kumasi. His Excellency the Acting Governor, Dr. J. C. Maxwell, C.M.G., was kind enough to support the Health Authorities in this respect by passing through Kumasi early in July instead of staying in the area and holding meetings with the Ashanti Chiefs.

His Excellency the Governor, Sir Gordon Guggisberg, K.C.M.G., D.S.O., also very kindly decided to pass through Kumasi when travelling through the provinces in September. Had His Excellency stopped in Kumasi the holding of a durbar would have been inevitable owing to the desire of the Ashanti Chiefs for many miles round Kumasi to come in with their people to tender their loyalty to His Excellency. If this had taken place a very real danger would have arisen of widespread dissemination of plague not only within the town boundaries but also later all through the surrounding districts.

The chief Mohammedan festival of the year took place in the middle of July at the height of the outbreak but, on representations being made to him by the writer, the Sarikin Zongo took steps to modify the usual rites and ceremonies so that there was a complete absence of the usual large crowds of worshippers.

(i) GENERAL SANITARY MEASURES.

The town of Kumasi extending over an area of nine square miles was found to be most inadequately equipped with sanitary structures. This was, presumably, partly due to the lack of funds in the past with which to provide these necessary structures and partly to the rapid growth of the various new townships outside the older portions of the town but well within the town boundaries. When the writer took over duties of Medical Officer of Health on the 12th of June the following sanitary structures were to be found :—

Latrines	..	..	..	36
Incinerators	..	..	..	22
Wash Houses	..	..	..	6

Together with the troops and their families in Cantonments the population of Kumasi is estimated at between 25,000 and 30,000. In connection with this it is generally agreed that the census figure of 1921 does not represent the actual population of Kumasi to-day in any way. The actual "seating" accommodation in the thirty-six latrines was 441 pans this means that with a population of 27,500 there was one "seat" to every sixty-two persons.

Moreover, in certain of the new townships the accommodation was either inadequate—thus there were but two public latrines for all the inhabitants of Odumasi, Menhia and Osofokrom quarters of the town—or else absent altogether as in the case of the Zongo Extension, Bimpeh Hill, New Asafo and Bantama.

As an inevitable result the greater part of the outskirts of these areas was a large open latrine.

Similarly, owing to the absence of public incinerators or dust bins in many areas and to the complete inadequacy of such structures in other areas the surrounding bush, open spaces and lanes were used as dumping grounds for household refuse.

As far as possible these defects were remedied in part by the provision of a number of fly-proof modified Salga type latrines and in part by establishing a number of areas where refuse could be dumped and burnt.

During the course of the outbreak twenty-four of such latrines were constructed preference being given to those areas where no provision at all had been made previously. This number represents but a small proportion of those actually required.

Additional latrines are required more especially in certain low lying and crowded portions of the town where the use of the modified Salga latrine is impracticable owing to the high level of the subsoil water, etc.

A scheme was devised for the disposal of nightsoil by motor lorries.

Nightsoil had hitherto been carried by head load through the streets of the town to entrenching areas so situated as to result in contamination of one main water supply for the town and one subsidiary supply for certain villages on the outskirts.

A letter (No. 163/1/1924) to the Honourable Chief Commissioner of Ashanti dated 18th of June, 1924, received his support and the scheme was sanctioned by His Excellency the Acting Governor.

Under this scheme nightsoil is expeditiously removed by motor lorry from the town to a new nightsoil depot where pans are emptied, cleansed, and disinfected.

Further incinerators and fly and rat-proof drying sheds are also urgently required in the town until a large destructor of the Horsfall type can be constructed outside the town area. Under present conditions only a proportion of the destructible refuse can be disposed of by burning. Owing to the heavy rainfall at certain times of the year (58-60 inches per year) the refuse become too damp to permit of its being burnt.

As a result, refuse tends to accumulate in the vicinity of many of the incinerators and has to be burnt as well as possible in the form of bonfires. When it is understood that much of the refuse consists of green plantain skins and such material the difficulty of disposal will be appreciated. In any case, tins and bottles and other indestructible refuse have to be disposed of by burial. This entails the using up of valuable building land and in many areas almost all the land for some distance round the incinerators has been spoilt in this way. Needless to say, dumps of refuse, tins, etc., provide excellent nesting places for colonies of rats.

The writer would prefer to have all refuse cleared twice daily from rat-proof and fly-proof sheds to a dump outside the town area where the refuse could be disposed of by partial burning, used for filling swamps and be covered with two feet of earth.



To show depth to which latrine pits are dug—26-30 feet below ground level. Note under cutting of deeper portion of pit to increase capacity.



To show modified Salga-type latrine in course of construction. Mud floor complete at back portion of latrine except for cement rendering. Note covers, tin for corn cobs, bottles of disinfectant. In background two latrines white washed and roofed in use.



Roofing a modified Salga-type latrine.



Floors and walls rendered with cement to facilitate cleansing. Note covers pierced by holes covered with mosquito gauze to render flyproof. Kerosene tins contain corn cobs and rags used instead of toilet paper and burnt daily.



The area behind the modified Salga-type latrine was originally a malarious swamp until filled-in by order of the Chief Commissioner of Ashanti, John Maxwell, Esq., C.M.G., during the summer of 1924.



Modified Salga-type latrine constructed at Bantama, Kumasi, in July, 1924.



Voluntary clearing of the bush and refuse round the outskirts of the Zongo and Zongo Extension. This work was carried out at the writer's request by the Sarikin Zongo.



As above.

To combat this, a scheme was devised for the construction of an adequate number of fly-proof and rat-proof dustbins from which refuse was to be removed daily by motor lorry to an area outside the town where it was to be dumped as much being burnt as possible and the remainder used for filling up low lying ground. The removal of indestructible refuse from the town met with the approval of Sir William Simpson who, however, considered that attempts should be made to burn all destructible refuse by means of additional incinerators until a destructor of the Horsfall type had been constructed outside the town area.

(2) The townspeople were educated during the course of house-to-house inspections in the principles of sanitation and those who failed to act upon the advice given were prosecuted. With practically the same number of staff available for routine duties—the additional staff after the epidemic had been in progress for some time being used on special plague duties, *e.g.*, disinfection—the sanitary summonses for the month of June, July and August numbered 449, 727, and 762 respectively as compared with 124, 149, and 139 during the three months prior to the writer's arrival in Kumasi.

(3) Large areas of bush in and around the town were cleared and in the process vast accumulations of tins, bottles and refuse were disclosed and disposed of.

In this work round the Zongo and Zongo Extension the Sarikin Zongo after a short preliminary disagreement with the writer as to who was the Sarikin Zongo as far as sanitary matters were concerned—gave a great deal of assistance. On many occasions when he was asked to have areas cleared of bush, refuse etc., the Sarikin turned out hundreds of his people to do work which could never have been done with the sanitary labour available.

In this most creditable work the Sarikin quite put to shame the Ashanti Chiefs in the town of whom none, with the exception of the Chief of New Asafo who gave a little assistance, rendered the slightest assistance to the Health Authorities.

(4) Other sanitary measures consisted in alterations to house property including demolition of insanitary dwellings, the removal of enclosed and subdivided verandahs, the cutting of windows. Insanitary dwellings demolished comprised 129 compound houses containing a total of 802 rooms. The number of these necessary demolitions by no means represents the number of insanitary dwellings in Kumasi for only a proportion could be demolished owing to the fear that further demolitions would result in overcrowding thereby creating one nuisance and danger by abating another. The remaining buildings were rendered as sanitary as possible by seeing that owners or occupiers constructed windows to each room, removed enclosed verandahs, demolished portions of their houses and rooms built in the central yards of compounds, concreted floors, cemented and whitewashed walls inside and out.

New windows to the number of over 3,000 were constructed in the Zongo and Zongo Extension (to mention one district only) sometimes with the help of a little forceful persuasion and the assistance of a *foufou* stick with which to make the hole through the mud walls.

Every building in one badly infected area comprising 22 compound houses and 261 rooms was demolished and the occupants were housed in a temporary hut camp. This action was taken following upon advice kindly given by Sir William Simpson.

In connection with the housing of dispossessed the writer wrote to the Honourable Chief Commissioner on the 6th of July, recommending "that Government be asked to vote an adequate sum to enable the worst areas of the Zongo to be cleared and for provision of houses for the dispossessed. Unless a large view is taken of this matter there will be a repetition of such outbreaks of disease as the present with resultant preventable loss of life and waste of money". Accommodation for dispossessed in the form of 50 compound houses to be built as an instalment on high ground north of Zongo Extension was asked for. Although this was delivered to him on a Sunday morning, the Chief Commissioner took immediate action instructing the Senior Public Health Engineer to draw up a scheme with the result that His Excellency, the Acting Governor, sent a despatch to the Secretary of State who approved by cable of a scheme costing £30,000 to construct a portion of a new zongo comprising 500 rooms for some of the dispossessed from badly infected areas of the Zongo and Zongo Extension.

The work is in hand at the time of writing and should be completed this year. A plan of the type of house and the general layout—both of which met with Sir William Simpson's approval—is appended.

Other sanitary measures taken in connection with the epidemic were directed to the amelioration of the water supply and food supply of the town.

(5) Recommendations were made (*vide* Letter No. 77/4/1924 to The Honourable Chief Commissioner of Ashanti dated 18th June, 1924) regarding the improvement of the existing water supplies—until such a time as the much needed pipe-borne water supply is available—by raising the coping of wells, covering same, fitting pumps, establishing a system of tanks and chlorination at four of the chief wells, paving and draining the surroundings of wells, protecting

the immediate vicinity, from fouling by surrounding such areas with by corrugated iron fences, supplying water to Europeans by motor water lorry instead of by head load in pans as is done at present. The majority of these recommendations met with the support of the Chief Commissioner and with the approval of Sir William Simpson.

(6) As regards the amelioration of the food supply of the town it had long been felt that the main Kumasi market should be extended or removed to another site. The site originally chosen was found to be less suitable than a second site originally intended for use as a public park and it was agreed, in June, that the park site should be used as site for the future market. This met with Sir William Simpson's approval.

Recommendations were submitted with regard to the construction of a new market to replace the present most insanitary and overcrowded one and market sheds will be erected immediately the sanction of His Excellency the Governor has been obtained.

Endeavours were made to render the present main market less insanitary by arranging market vendors according to their produce and also in straight lines to enable the market labourers to clean the intervening lanes. Special attention was paid to the areas immediately around the market and numerous demolitions and alterations to buildings were effected. The market, however, admits of little or no radical improvement and in its present condition is a menace to the health of the town.

Happily, a very real improvement could be effected in the Zongo Market consisting of about 400 vendors. At the beginning of the outbreak this market was covered with so-called "buggas" or hovels constructed out of old sacking, mats corrugated iron sheets or kerosene tins.

These hovels housed vendors, lepers, lunatics and diseased persons by day and while a lesser number of *bona fide* vendors, *e.g.*, firewood sellers slept there, the same number of diseased persons and, in addition, various riff raff and homeless sheltered by night. The market was quite incapable of being cleaned and harboured a large colony of rats.

The Sarikin Zongo was persuaded to have the whole area cleared and, later, with the sanction of the Chief Commissioner, two long, airy market sheds were constructed to house 198 vendors and four butchers—the butchers section being rendered with cement and fitted with cement concrete slabs and fly-proof safes hanging on pulleys.

Three more market sheds are required to make this market completely satisfactory.

In connection with the food supply of the town it should be stated that the arrangements for the slaughter of cattle and the sale of meat in Kumasi leave a great deal to be desired.

The present public slaughter house is too small for a town of the size of Kumasi, the accommodation for the slaughter of sheep, goats and pigs is almost non-existent, there is insufficient cooling room accommodation and no water supply is available to flush out the building and no efficient means exist of disposing of the unwanted offal. Moreover, joints of meat have to be carried through the crowded—and in the dry weather—dirty streets exposed to dust, flies and road detritus. The market stalls except those constructed in the new Zongo Market during the epidemic have no wire gauze fly-proof safes.

Recommendations have been made with regard to a new site for a properly equipped slaughter house—not one situated within a short distance of a public latrine and two large incinerators.

(7) While discussing the question of foodstuffs it should be stated that the inhabitants of Kumasi more particularly the Hausas, Lagosians and Northern Territory elements, have a regrettable habit of keeping stores of unprotected foodstuffs, *e.g.*, maize, plantains, etc., in their living rooms and bedrooms. This naturally tends to attract rats to the premises with unfortunate results if the rats happen to be infected with plague. Endeavours were made to persuade the occupiers of houses to keep their foodstuffs in closed tins or in concrete and brick buildings built for the purpose.

(8) The large number of horses in the Zongo and Zongo Extension tended to aggravate the insanitary conditions and the danger from plague. Horse owners were first persuaded to remove their horses with their litter of guinea-corn, maize etc. affording shelter and food for rats, to open spaces or lanes adjoining the compounds and eventually after much trouble were induced to take them all to a large open space the site of the old Mohammedan Cemetery. and to build temporary buildings for the animals on the Cemetery.

(9) Little could be done in the way of sanitary measures with regard to the drains of the town but attention was paid to improve the area by numerous graded channels lined with brick etc. it being realised that anything adversely affecting the health of the inhabitants militated against the suppression of plague. Moreover, large earth drains and washouts provide excellent rat breeding areas.



A badly infected portion of the Zongo.



The badly infected portion referred to above after demolition. The inhabitants were evacuated to a temporary camp.



The Sarikin Zongo was persuaded to remove horses from compounds and living rooms in the infected area, first into neighbouring lanes and open spaces and, finally to a large open space at some distance from houses. The Sarikin was further persuaded to build stables for some forty horses as a temporary measure until the government could erect sanitary stables to let out on hire.

(10) Large numbers of labourers recruited in the Northern Territories are brought down to entrain at Kumasi for work in the mines or on railway constructions and deviations on the Accra and Sekondi Railways. They are often of poor physique, half starved, very dirty, lousy and ill-clothed and frequently are found to be suffering from chronic ulcers, dermatoses and adenitis. During the outbreak endeavours were made to see that no gangs left Kumasi by rail unless they were free from serious disease and had washed themselves and their clothes ; and towards the later part of the outbreak certain among the contractors of labour were persuaded to give their labourers a new outfit so that the dirty and lousy clothes could be discarded and burnt. This was done not only with the object of protecting outstations from becoming infected with plague but also to prevent Kumasi itself from becoming re-infected from such outstations.

It is advisable, however, that legislation should be introduced to make compulsory the medical examination of labour gangs and their issue with clean kit.

(XIII) RECOMMENDATIONS.

Kumasi is in need of the following provisions which will render less probable the occurrence of epidemics of fatal diseases similar to the one which forms the subject of this report, with the inevitable loss of human life and waste of money :—

- (1) An adequate pipe-borne water supply.
 - (2) A complete surface drainage system including the drainage and filling of swamps in the town.
 - (3) An efficient refuse disposal system whereby all household refuse—not merely tins and bottles and indestructible refuse—is removed twice daily by covered lorry to low lying areas outside the town where it can be incinerated in a small Horsfall or dumped, burnt in situ and top dressed with earth.
 - (4) A large, airy market capable of being flushed out daily with water. This will enable the old, insanitary market, and the large number of small subsidiary markets along most roads and blocking up lanes, to be abolished and will enable the conditions under which food is sold to be properly controlled. The butcher's section of the new market will require to be equipped with means of flushing stalls and with fly-proof stalls.
 - (5) A new public slaughter house provided with flushing tanks and adequate cooling space.
 - (6) Means of carrying joints of meat from slaughter house to market in a closed, fly-proof and washable van.
 - (7) Progressive housing schemes and layouts similar to the one in process of construction as a part of the new Zongo, followed by demolition of the many congested areas in Kumasi.
 - (8) Increase of sanitary staff. A town of the size and importance of Kumasi should have at least twelve instead of six permanent trained sanitary inspectors and two instead of one European sanitary inspectors.
- In addition, there should be a permanent trained laboratory assistant who would not only carry out the most necessary routine examination of rats but who would also be available for testing water samples and doing bacteriological examinations for the Assistant Director of Medical Services and the Medical Officer, Kumasi.
- (9) Increase of staff under the European Building Inspector.
- Under existing conditions the European Building Inspector has too many duties to perform, for example, clerical work in connection with mortgages, leases, etc.
- In consequence, insanitary and dangerous new buildings and additions to existing buildings are constructed all over the town. Certainly, demolition notices can be served, but so many are needed that their enforcement is impracticable, and in any case if they were enforced it would react harshly on the native who is quite prepared to put up safe and sanitary buildings if the European Building Inspector staff were sufficient to allow a proper supervision of the work and of the giving of practical advice on building construction.
- (10) Electric Lighting is most important from the sanitary as well as from many other points of view.

Good lighting makes householders feel much more secure and thus encourages the keeping open of windows and this is most important as a deterrent to plague infection and dissemination and equally important as a means of combatting the scourge of tuberculosis (which the writer showed to have increased 100 per centum in ten years in Accra in his Annual Report for 1922).

Good electric lighting also helps to check the fouling of streets, lanes and drains with excrement and refuse, and also acts as a check to crime.

(11) The majority of the above are dependent, of course, on a well considered town survey and layout.

(12) Additional legislation is required on lines of Chapters 55 and 65, Laws of the Colony, licensing of palm wine vendors and other persons preparing food, the control of immigrant labourers.

No mention has been made in the above recommendations with regard to the provision of public latrines, drying sheds, wash houses, etc., as the writer understands that His Excellency has graciously sanctioned the expenditure on these very necessary structures.

No mention has been made either of the provision of maternity homes, creches, infant welfare, ante-natal and venereal clinics, of the issue of quinine to school children or of many other methods for improving the health of the community since these are of subsidiary importance until the urgent necessities referred to in the above recommendations are obtained for the town.

P. S. SELWYN-CLARKE, M.D.



Part of the New Zongo Housing Scheme. (Buildings not yet completed and construction of sanitary structures not yet commenced.)

(XIV) APPENDIX.

1. Circular to Europeans in Kumasi urging Anti-plague Vaccination.
2. Public Notices to Intending Passengers by Train from Kumasi.
3. Letter to Provincial Inspector of Schools, Kumasi, asking for co-operation of Schools in Rat Hunts and General Clean up of Town.
4. Letter to District Commissioner, Kumasi, relating to Anti-Rat Campaign.
5. List of Prosecutions for Offences connected with Quarantine Regulations.
6. Detail Report on Housing Conditions in Kumasi Old Town by Dr. W. M. Howells in charge of District 1, 2 and 3 from the 8th August to end of Epidemic.
7. Map of Zongo and Zongo Extension showing Premises where Cases of Plague occurred and where Infected Rats were trapped.
8. Plan of Additions to Contagious Diseases Hospital.
9. Plan of New Zongo Housing Scheme.
10. Résumé from date on which Main Report was submitted—4th October, 1924 to 31st March, 1925.



On the left one of the street drains lining an important street. On the right in the background can be seen several unauthorized corrugated iron buildings built over the right half of the public street.



Kumasi Slaughter House. The building is inadequate in size and no means exist of flushing it with water. On the roof are a number of vultures. The presence of this bird is a reflection on Kumasi. The assistance of such foul feeders in dealing with town refuse should not be required.

APPENDIX I.

CIRCULAR No. 4/1924.

SANITARY DEPARTMENT,
KUMASI.

19th June, 1924.

PLAGUE IN KUMASI—PROTECTION AGAINST INFECTION.

It is extremely advisable that all Europeans in Kumasi should obtain the greatest protection possible against being infected with the organisms of plague by submitting to vaccination with Haffkine's anti-plague vaccine.

2. The Assistant Director of Medical Services, Dr. W. M. Wade, the Medical Officer, Dr. P. D. Oakley, and the writer will be glad to vaccinate volunteers who have not already received such protection from attack.

3. In this connection the following statistics relating to a recent serious outbreak of plague in Baghdad are of interest. In the course of a few days when about one-half of the population had been protected by vaccination whilst the remainder were not so protected, only ten cases of plague and four deaths occurred amongst the vaccinated half of the population whereas 226 cases and 186 deaths occurred amongst the non-vaccinated population—In other words anti-plague vaccination protects 22 times against attack and 46 times against death.

4. It is of interest to note that in a recent serious case of plague in the Colony in a European the patient was probably infected through his servant.

5. It is a matter of vital importance that all should attend to the cleanliness of their premises and of the immediate precincts of same. Dirt attracts cockroaches and these attract rats. Care should be taken to render all food stores rat-proof and no render providing food or nesting places for rats and mice should be permitted on premises.

The presence of rats both alive or dead should be reported to the writer. Care should be taken not to handle the bodies of dead rats. These should be lifted with a shovel and placed in empty kerosene tins.

(Sgd.) P. S. SELWYN-CLARKE,

Medical Officer of Health.

APPENDIX 2.

PLAGUE IN KUMASI.

Europeans desiring to leave Kumasi by train on and after the 21st instant should furnish themselves with passes.

Medical passes to such passengers will be issued at this office at 4 p.m. on the day prior to that upon which the intended journey is to be made.

(Sgd.) P. S. SELWYN-CLARKE,

Medical Officer of Health.
20/6/1924.

PLAGUE IN KUMASI.

Owing to an outbreak of plague in Kumasi intending passengers by train will be medically examined at Kumasi Station before being allowed to board the train.

On the 21st instant, and subsequently intending passengers by train should attend for medical examination one hour before the departure of each train.

(Sgd.) P. S. SELWYN-CLARKE,

Medical Officer of Health.
20/6/1924.

APPENDIX 3.

No. 147/62/1924.

SANITARY DEPARTMENT,
KUMASI.

21. 6. 1924.

PLAGUE IN KUMASI.

I should be grateful if the schools in Kumasi could assist in the prevention of further cases of plague in the town by (1) a general clear up of refuse in the scholars' own compounds and in the lanes and open spaces adjoining, and (2) by assisting in the destruction of all rats and mice and of their nesting places.

In connection with (1) supra, all refuse should be taken to the public incinerators or to the dumps set aside for this purpose by the Sanitary Authorities, and refuse should not be deposited in small heaps in the bush as is being done at present.

In connection with (2) supra, it is desirable that concerted rat hunts should take place in the different quarters of the town at the same time. The sum of 2d. will be paid for every rat dead or alive, brought to this office.

The bodies of rats should not be handled but should be carried here in kerosene tins.

If possible, I should be very grateful if the rat campaign could commence after school hours on Wednesday, 25th, on which day the Chiefs and townspeople have been asked to take part in the campaign.

(Sgd.) P. S. SELWYN-CLARKE,

Medical Officer of Health.

THE PROVINCIAL INSPECTOR OF SCHOOLS,
KUMASI.

APPENDIX 4.

No. 147/59/1924.

SANITARY DEPARTMENT,
KUMASI.

21. 6. 1924.

PLAGUE IN KUMASI.

With reference to my memoranda to you relating to a general clear up of the town and its surroundings by the Chiefs and their people, I should be grateful if you could use your influence to induce *all* the townspeople to assist in a rat-campaign in Kumasi.

It is desirable that such a campaign should be carried on simultaneously in all districts of the town and I should be glad if activities could commence on Wednesday, 25th instant.

The schools have been asked to co-operate and to commence rat hunts and the destruction of the nesting places of rats and mice on that date.

In connection with rat hunts, it is not desirable that the bodies of dead rats should be handled in any way.

When killed, rats should be placed in empty kerosene tins and brought to this office for examination.

The sum of 2d. will be paid for all rats brought to this office from now until further notice.

(Sgd.) P. S. SELWYN-CLARKE,

Medical Officer of Health.

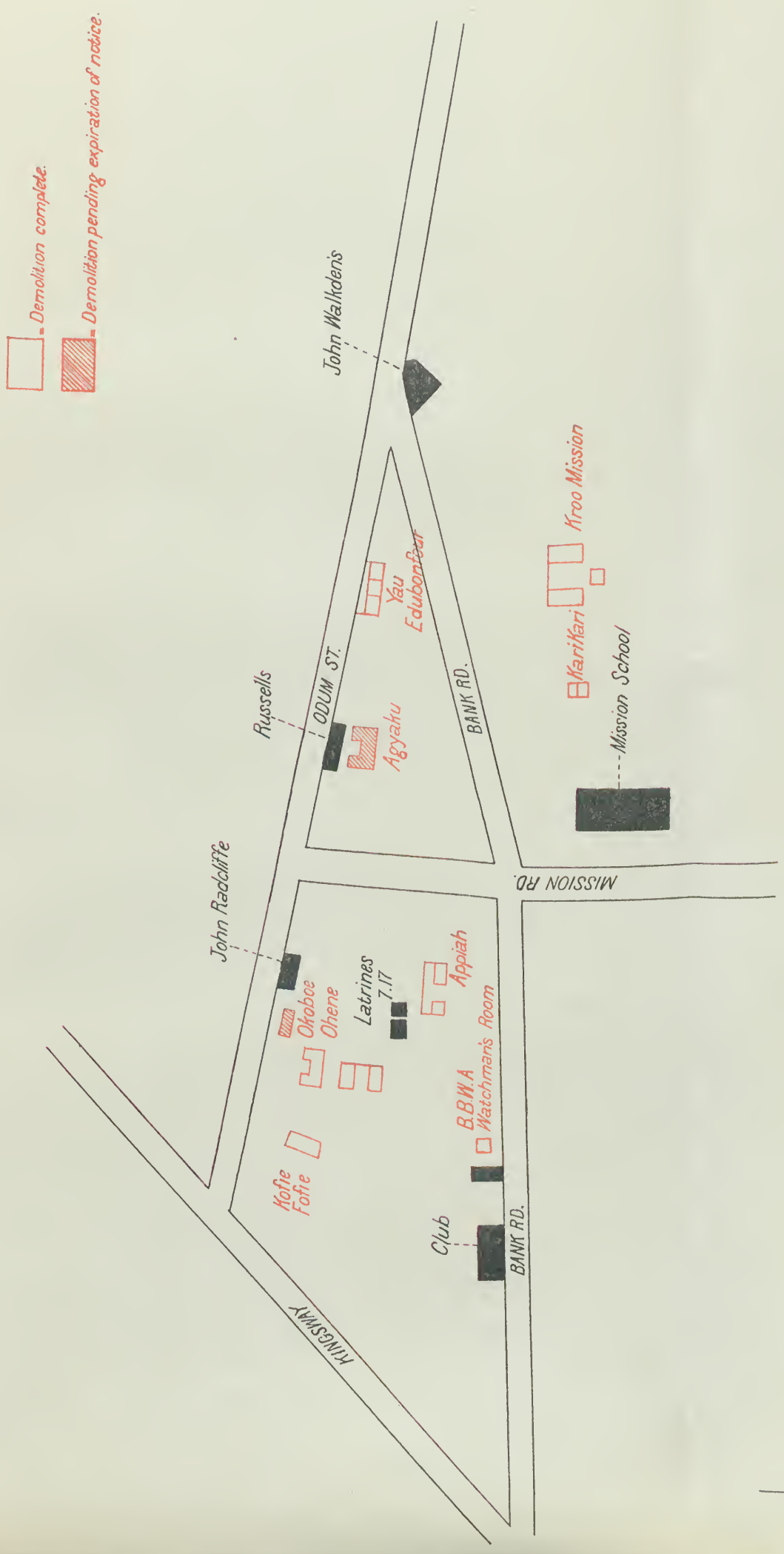
THE DISTRICT COMMISSIONER,
KUMASI.



A portion of the congested and insanitary Central Market of Kumasi.



New sheds erected in the Zongo Market, Kumasi to replace the insanitary "Buggas" demolished in June. Note Butchers stalls with flyproof safes, washable cement tables and floor. Flyproof Dustbin in foreground.



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APPENDIX 5.

RETURN SHOWING NUMBER OF CASES AND PERSONS PROSECUTED IN CONNECTION WITH
THE OUTBREAK OF PLAGUE IN KUMASI (JUNE TO SEPTEMBER, 1924).

JULY.

No. of Persons Prosecuted.	Offence.	Fined.	Imprisonment.	Cautioned.	Case Withdrawn.
8	Attempting to deceive Public Officer (M.O.H.) Omitting to report case of Sickness. AUGUST.	4	2	Nil.	1 (one discharged)
40	Attempting to deceive Public Officer (M.O.H.) Omitting to report case of Sickness. Failing to present himself for Medical Examination. SEPTEMBER.	26	Nil	5	9
20	Attempting to deceive Public Officer (M.O.H.) Omitting to report case of Sickness. Failing to present himself for Medical Examination	17	Nil	3	Nil
Total 68		47	2	8	11

APPENDIX 6.

13th October, 1924.

To

THE MEDICAL OFFICER OF HEALTH,
KUMASI.

As instructed, I beg to forward a short report on the Districts 1, 2 and 3 of Kumasi Old Town.

It is supposed to deal in the first place with housing conditions in the older parts of the Town, with special reference to the occurrence of plague.

It appears that next to the question of rats, all sanitary conditions must apply nearly equally.

The older parts of Kumasi have therefore been discussed very shortly from a general sanitary stand point.

(Sgd.) W. M. HOWELLS,

Medical Officer.

DISTRICT 1.

This District can be readily divided into two areas. One, situated between Bank Road and Prempeh Road, consisting chiefly of large stores, offices, large compounds consisting of godowns, cocoa and wholesale stores.

The other chiefly comprising small native compounds. This district, even in its worst spots, is not so congested as corresponding areas of District 2 and 3.

The demolitions, carried out in District have served to open out the area in the vicinity of Latrines 7 and 17, the Mission Area, and the Mission Road—Odum Street junction. The open spaces in this district between Odum Street and West Approach Road, round Latrines 7 and 17, and the area round Latrine 22, were littered up with insanitary wash places latrines, kitchens, hen houses, etc. The majority of these have now been pulled down. All these minor demolitions were effected without the serving of notices.

All kinds of native compounds are to be found—burnt brick (a few), swish brick, (sometimes washed with cement), and mud and wattle.

There are far too many permanent, corrugated-iron, living rooms scattered about among the compounds.

Most of the mud and wattle buildings have now been demolished. The rooms of such compounds are always far too small. If adequate windows are cut into them, it usually means the destruction of a wall. They cannot be kept clean.

They are almost invariably roofed in with rotten shingles.

These leak badly in the rain ; and when dry are always dangerous as potential foci for fire raising.

Often a rotten shingle roof is provided with a second covering of corrugated iron, placed six inches or so, above it.

The rotten shingles, and the space between them and the iron, are often stuffed with rubbish and are ideal refuges for vermin.

In Kumasi Old Town such living quarters are usually let to Hausas, etc.

If one is demolished, the occupants can often be rediscovered living in a similar dwelling in the near vicinity.

They have simply been ' moved on.'

Considerable attention has been paid to wash-places, in seeing that the floors are properly cemented and drained. These conveniences are often used as stores, latrines, and hen-houses.

The combined latrine, wash place and hen-house has been seen often.

A striking feature of most compounds in Kumasi Old Town is the amount of stored water. Often three barrels filled with water can be found in quite small compounds.

Eight such barrels were counted round the staff living quarters of the Scottish Mission on one visit.

When work in the three Districts of Kumasi Old Town was started speed seemed to be the most important factor.

The worst places were demolished as soon as possible. The badly lit and ventilated quarters were supplied with an adequate number of windows. Carpenters and masons were not present in sufficient numbers to put all the work in hand at once ; so the worst living quarters were first of all concentrated on. In later rounds of inspection attention has been paid to detail, an attempt being made to raise the standard of all living rooms.

A very interesting area was that on Kingsway, just below the Anglo-Guinea store, opposite the Post Office.

This area comprised four compounds. Most of these compound areas were roofed in with sheets of corrugated iron, from roof to roof, so as to make an almost completely covered in yard area.

These were all taken down ; and several verandah rooms were demolished.

Over 30 windows were ordered to be cut in these four compounds. Many floors were cemented, and rooms whitewashed.

This area is now much improved.

The area, next above this, comprising the stores of the Anglo-Guinea and Swanzy's with the store-rooms behind the shops, and the living quarters above them, are very bad. The buildings are also apparently unsafe and very old.

Particular attention has been paid to these, as plague-positive. rats have been trapped in the vicinity, since quarantine was lifted.

When some more building has been completed, it is considered that the advisability of demolishing these two buildings should be considered.

In District I, especially in Kingsway and Odum Street there are many bricked-in verandah areas. These are usually situated on the ends of blocks of shops, and are occupied by petty-traders. These obstructive, small, stores, and the stair-ladders run up the ends of these blocks to provide extra access, (made necessary by the sub-division of upstairs living quarters,) constitute grave obstruction to any method of providing proper windows. This practice of sub-division of living quarters, and also of shops, is quite a menace.

District 2.

The chief characteristics of this area are the number of open-spaces, and the presence of the market.

(a) *The open spaces* are generally very unsatisfactory. Almost their whole area consists of very shallow burial-pits where tins and bottles have been buried over a period of years. Rats, and bandicoots find plenty of cover in such places. They burrow down among these tins and bottles. Their earths are often very extensive.

Often broken off, half buried, bottles have been found breeding out mosquito larvae.

DEMOLITIONS DIST 2

Dist 2.

Dist 2

E. Series

Malamali
Malamali



Demolitions completed.

Demolitions pending expiration of notices.

Kwadjo Weredu

Prison

Mortuary

Incinerators
13

Warders Qrs

Chief
Kwadjo Akotoe

Mensah
Carpenter

GREEN WALK

PRISON RD

Kwabla Tie

John Walkdens

Market

Kwadjo Wusu

Yaw Nemesah
Aduborfoorh

Kweku Nkrunkran
Amanhwa Tie

Kwaku Dua

Amah Nyamie

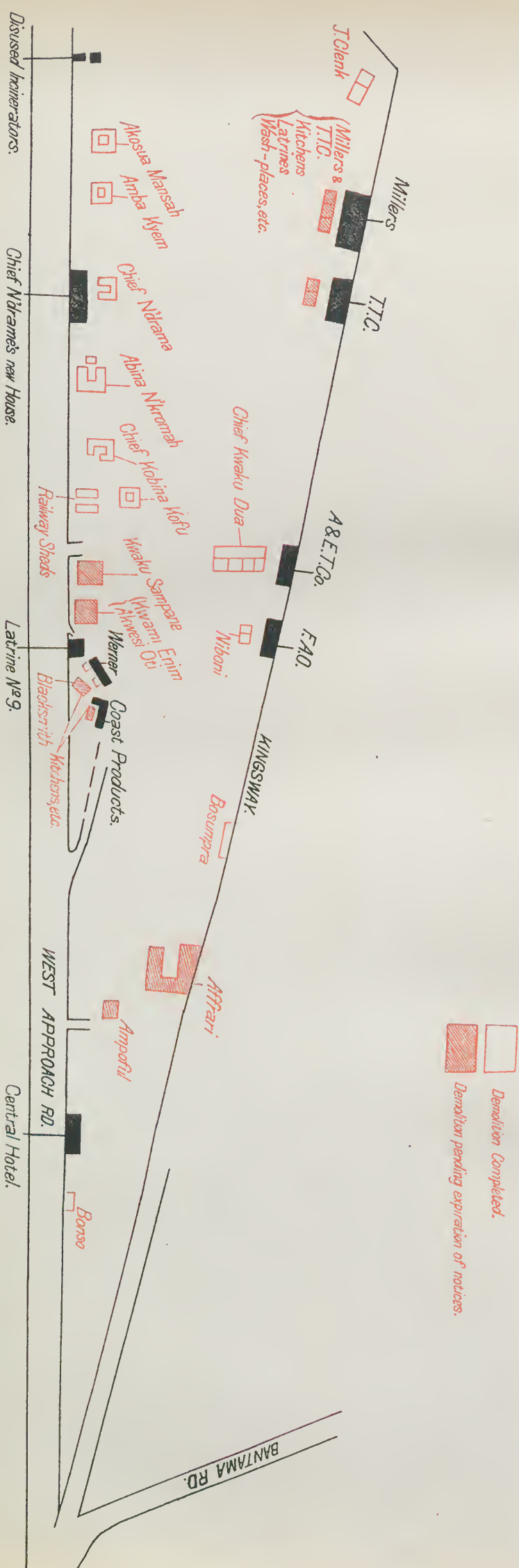
Kweku Bempah

KINGSWAY

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DEMOLITIONS.



The danger of the continued burial of indestructible rubbish is manifest ; especially when shallow, and situated in open spaces in a Town Area.

These areas have been laid bare and the superficial tins and bottles lifted.

Earth has been rammed over these spots ; and all open rat-burrows have been filled with well rammed-in rubble.

This is repeated from day to day, as closed earths are re-opened by the rats.

This work now has not got to be repeated anything like as frequently as formerly.

(b) *Chief's Burial Grounds.*

These are a frank nuisance.

The chiefs do not permit these being cleaned up by anybody else, and do next to nothing to them themselves.

The surrounding compounds dump all sorts of filth on them. The chiefs do not seem to object to this dumping in the slightest. These areas used to be the happy-hunting grounds of stray dogs before their great reduction in numbers.

(c) *The open space between the Police Station, and Bantama Road, " E " Lines, and No. 2 District.*

This area is a continual source of anxiety : and will require frequent clearing (being chiefly covered with " Elephant Grass "). Formerly this whole area was dotted over with private latrines, wash places, hen houses, etc., and over-grown food farms. All these now have been pulled down. The farms have been cleared of undergrowth and tins and bottles lifted.

It is, however, repeatedly fouled.

All inhabitants have been warned that any dirty garden-plot will be at once cut down.

This area used to be used for unauthorised slaughtering. Offal of sheep carcasses frequently being found among the undergrowth.

(d) *Little more remains to be said of the unsatisfactory state of the Market.*

A good deal of clearing of insanitary premises has been carried out round it—particularly the area between the Mission and the Market. Many of the stalls are grossly insanitary. The floors are mainly composed of rammed earth. Where these are raised, and edged with rough stone, rat burrows were often found. This was also true as regards the masonry of the Market Well, and of the raised verandah platforms of the stores surrounding the Market Square.

These now have been cemented up.

The stone-work of the Market Well has not yet been put into repair.

In the early morning rats could often be seen running from the heaps of swept up rubbish, and taking refuge in the various holes in the surrounding stone work.

No rats have been seen in, or around the Market for several weeks now on the early morning inspection.

It is considered that the Market closure at 6 p.m. should be strictly enforced.

Unauthorised sellers were in the habit of taking over the stalls as they were vacated by their rightful owners, who had cleared them of all rubbish before leaving.

The result was, at 6 a.m. the following morning, several of the stalls so taken over were found to be very dirty. This left standing over night must have acted as a great attraction to rats.

The Police patrol at night—at closing time—has done much to prevent this unauthorised selling, and subsequent fouling of the stall areas.

(e) *The Stores surrounding the Market Square :*

These are very unsatisfactory in every way. They are double storied, swish buildings standing on a very small ground area. Above are dwellings ; below are stores.

Many of the buildings appear unsafe.

As dwellings they are insanitary. There is no of possibility providing them with proper kitchen, latrine and washing places.

These were grouped on the balconies.

Another difficulty, in the rendering sanitary of these dwelling is the fact that the living quarters are often occupied by Syrians.

These people, considering themselves European, will not use the common latrines. When the old market ceases to exist, the demolition of all these old stores should be considered.

(f) *Storekeepers Quarters.*

Another nuisance, which is well exemplified in the Market Area, can be seen in the smaller Stores of the larger trading firms.

Often a portion of the store is boarded-off as a living quarter for the storekeepers. Frequently a family is found living under these conditions. These are always most unsatisfactory. Rarely is any provision made for cooking or washing places for these Storekeepers.

The result is that all sorts of insanitary structures make their appearance to the back of the store.

This is very common practice throughout Kumasi Old Town.

(g) *The Kingsway Stores :—*

The majority of these are now fairly satisfactory. There are several however, which still have work of sanitary importance to carry out *viz.* :—rat-proofing, window cutting, etc.

Most of the larger stores which are not occupied by large firms are still very unsatisfactory.

Where a landlord cannot let the whole store to a firm, he usually cuts it up into as many small premises as possible.

The number of these only being kept down to the number of doors leading into the building.

The partitions are usually made of sheets of corrugated iron. No account is taken of proper light and ventilation in the sub-division of these stores.

The landlords are apparently quite unaware that they cannot carry out such structural alterations without reference to the Building Inspector.

The practice is most obvious as often the only method of ventilation of such places is by means of door ventilation.

Such methods help, but can be of little real value, where these portions of stores are used as living quarters as well as small stores. The same splitting up of rooms is often seen in the upper stories as well. This necessitates the provision of further stair-ladders to give access to the increased number of apartments. These added stair-ladders are always obstructive.

Many of these upper stories are occupied by Syrians.

This makes fresh difficulty.

These people, who have no sanitary instinct whatever, consider themselves as Europeans and insist on their own latrine accommodation. The only place for these is on the balcony along with the kitchens and bath rooms.

(h) *Compounds and Native living Quarters generally.*

The compounds in this District, in the main, are perhaps built on less obstructive lines than in District 3.

Very many insanitary compounds still exist.

The whole impression conveyed to one is an impression of over-crowding.

For this reason alone demolitions have been curtailed to an absolute minimum.

People dispossessed by a demolition hardly ever go further a field and acquire a new site for re-building.

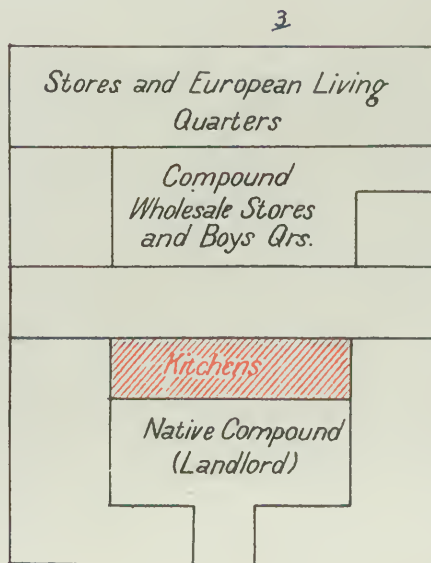
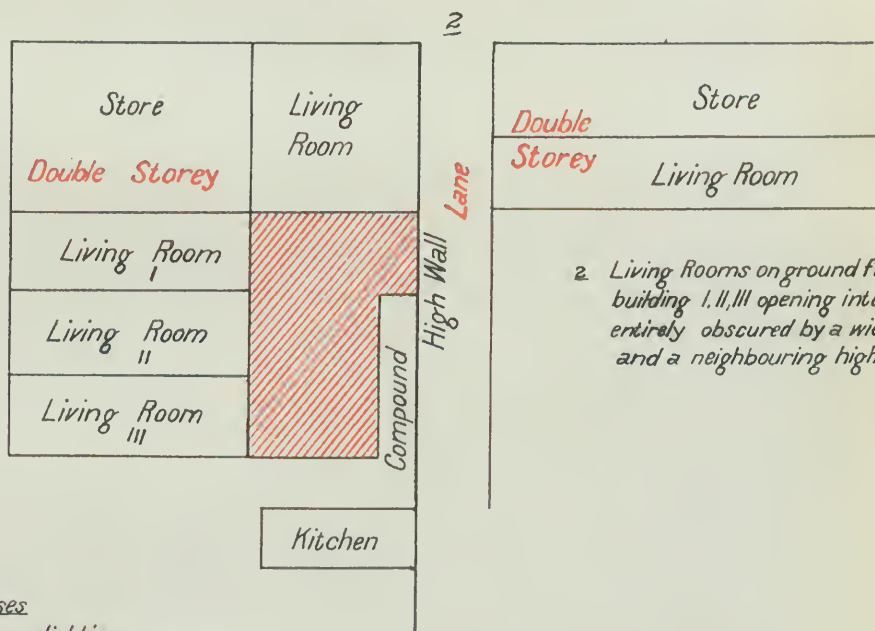
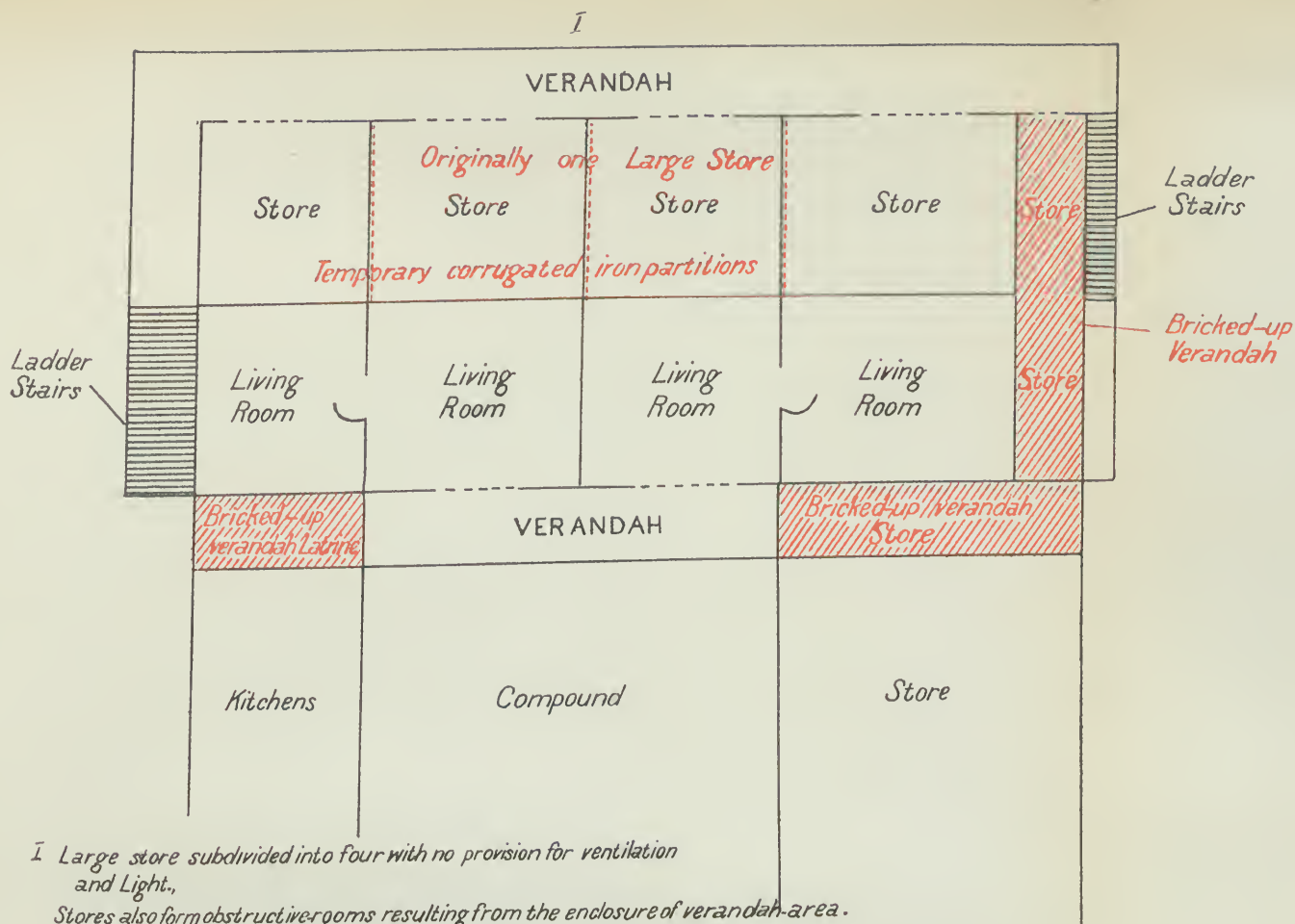
They simply crowd into adjacent compounds as lodgers.

A nearly true cellar dwelling was found in this area in the basement of a comparatively new, well built, brick house. It consists of four rooms. Three of the sides of these rooms are entirely underground. The fourth (front) wall is free to nearly its full depth.

This was the only building approximating to the underground dwelling found in Kumasi Old Town ; and in a modern house.

(i) *Drainage :*

In District 2 this is a big question, particularly in the system starting down Boundary Road, and proceeding down Meat Market Street, Dominase Street and Prison Road. Then it passes beneath Kingsway at the Prison Road junction and empties into the deep ravine which runs down to West Approach Road. This whole length requires clearing out at least twice a day. Men pass down it with brooms and sweep out retained pockets. If the liquid filth stagnates for a few hours an insufferable nuisance results.



Rough Plans of good class premises
rendered difficult as regards proper lighting
and ventilation, viz:-
1 Defects due to the addition of rooms made by
'bricking up' verandah area and the subdivision
of a large store.
2 Defects due to construction.
3 Defects due to addition of a second, attached,
compound.

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Night-Soil Depot. Motor conservancy system replacing carriage of night-soil through streets by head load.

This was dealt with in a short report, previously furnished.

DISTRICT 3.

This is a most difficult district to report on even shortly.

Three main questions arise 1. Housing

2. Drainage

3. Railway Living Quarters.

(1) Far more demolitions have taken place in District 3 than in District 1 and 2.

Grouped along West Approach Road, and in the central area between Kingsway and West Approach Road, are compounds which must be about the oldest in Kumasi.

Most of these have been demolished or their demolition is temporarily in abeyance pending the expiration of notices. Most of the notices served were on compounds and buildings which were unsafe as well as grossly insanitary. The areas opened out by these demolitions are :—

(a) That near the dismantled incinerator in West Approach Road.

(b) That behind the new house of Chief N'duama.

(c) The district just beyond (nearer Kejetia) the house of Chief N'duama.

(d) The area behind Latrine No. 9.

(e) The area near Latrine No. 28.

(f) The area behind French Company and the African and Eastern Trading Company in Kingsway.

The buildings demolished varied from the large double storied house of Chief Kwaku Dua—consisting of 12-14 rooms—to primitive compounds of swish and wattle, such as that of Chief N'duama.

Another type (such as that of Abina N'Kromah) was a solid swish building erected upon loose open stone work which was riddled with ratburrows.

The compound of this house was simply the remains of partly pulled down adjacent compounds.

Nothing more insanitary could well be imagined.

The last type is a compound so ruinous that really there was little excuse for its existence (such as Bonso's house near Latrine 28).

Many more compounds in this District really should be demolished as soon as possible.

It is felt that little more demolition can take place at present owing to a danger of over crowding the neighbouring, not very sanitary, compounds.

In the compound areas generally much work has been done in getting windows cut, floors cemented, compounds properly drained, rooms cleaned and whitewashed etc.

(b) *The Kingsway Stores also in Zongo Road and Odum Road.*

The same questions, raised in District 2, are found in District 3 as well.

Most stores now have put in windows. Many, however, are still unsatisfactory.

A lot of rat-proofing of floors has been carried out ; more remains to be done.

The chief haunts of rats appears to be not so much the stores themselves as various types of out-houses in the compounds behind the stores.

For example small cocoa-stores which have been standing empty. These may either have swish or broken cement floors, or again may have a sound cement floor which is covered with a plankfloor, raised about 3-4 ins above the cement.

Hen-houses often show large burrows. Fishcuring houses are also very bad ; due chiefly to the odds and ends of broken fish always lying about.

The question of proper kitchens, washing places and latrines for the storekeepers to replace the existing ones, is pressing. Several firms have started the work well, but, others are making difficulties. It is hoped that these will be gradually replaced. The practice of splitting up stores to make several petty traders stalls and living rooms combined is very common as elsewhere. When the new market is ready and stalls are available, the top-hamper which slopes down from the roofs of most of the stores and covers in the paved verandah area in front—as far as the edge of the gutter—might, it is considered, come down.

These areas provided with such head-cover seem to be occupied by all sorts of petty traders and food sellers.

The same also applies to the traders who have set up semi-permanent stalls in the lanes leading off Kingsway between the blocks of shops. All these stalls should come down later.

The Combine was asked to cement the area between the walls of the Arcade and the street gutter along Zongo Road.

This they have done.

This narrow strip of ground is let out to petty traders who are charged rent for it.

The cementing of these stall areas has rendered their cleaning much easier and more thorough.

The A. & E. T. Co., have now been asked to do the same to their piece of ground on the opposite side of Zongo Road.

They have promised to do this.

When this is completed, Zongo Road will be very much improved.

2. DRAINAGE.

The supply of properly graded street gutters is urgently needed.

This want is only too apparent in the small streets running down from Kingsway to West Approach Road.

The gutters here are simply chains of puddles as often as not running down the middle of the streets.

This renders the proper drainage of compounds impossible.

Most of these side streets in rain are impassable the water rushing down them like a river.

Much time is wasted in having to brush out the stagnant water from the puddles—Many in fact have to be baled.

There are also areas rendered very swampy by the height of the sub-soil water.

This is well seen in the open area on which Latrine No. 28 stands. The whole area bordering on West Approach Road from this point down to Kejetia is very much the same.

The site of the Railway living-quarters is also bad. Here a cement-barrel, let down into the ground, is often deep enough to top the sub-soil water.

Indeed, this method of obtaining water was formerly often adopted in this area.

At times the height of the sub-soil water brings it almost to a level with the floors of the shops at the bottom of Zongo Road, just above the Approach Road crossing.

It is possible that the projected scheme of cementing the course of the Insuben stream will greatly improve all this.

The culverts under the Railway are very unsatisfactory. These are continually silting-up and producing back pressure effects.

3. *The Railway Living Quarters on West Approach Road.*

These are situated on low-lying swampy ground. The quarters themselves are not sufficiently ventilated. The windows are glazed, and often found thickly covered with lacquer "to keep out the sun" (sic).

The grass surrounding these quarters is long and rank, and there is far too much extra vegetation—yam, cassava, banana and sugar cane. All this is simply cover for rubbish and filth of all kinds.

The inhabitants of these quarters are most dirty, and do not help in the least.

The Railway living quarters in District 1., between Raw Products Ltd. and the Railway are also unsatisfactory.

This area has been the subject of a short special report. All annexes have been removed. But the condemned wattle and swish buildings, of three quarters and kitchens, still waits demolition.

Some clearing of rank grass has been done, but the tins, bottles, etc., laid bare have simply been thrown a few yards further afield.



One of the street drains in Kumasi in 1924. Besides being dangerous to life and undermining houses, the sides of these drains are regular rat warrens. Note depth of washout.



Another street drain showing undermining of house property. Note Inspector standing in drain in background.

The cutting of extra windows, ordered, has been commenced. It is considered that the practice of "taking-in lodgers" by native employees of Government Departments in Government quarters, should be taken up with the various Government Departments. This practice, it is certain, exists to a much greater extent than is supposed.

It leads to overcrowding and all sorts of insanitary annexes, verandah-rooms etc., are built for their accommodation.

District.	Demolitions completed.	Pending Expiration of Notices.	Number of Rooms involved.
1	9	2	37
2	12	4	80
3	15	7	104
Total	36	13	221

Continuous watch has been kept on all rounds of inspection for cases of suspicious illness.

Any cases so found whether remotely resembling plague or not have been kept in touch with daily until well.

As far as is known no case of plague has arisen in Kumasi Old Town since it was taken over until the 13. X. 24, when a case was reported from Kejetia.

This short report contains nothing new. Most of the questions raised have cropped up and have been discussed many times before. It is felt, however, that such a résumé of the work attempted in Districts 1, 2 and 3 Kumasi Old Town should be placed before the Medical Officer of Health, not that any new ideas can be offered, but perhaps in the future, some part of this report may prove useful where independent evidence may be quoted in support of some projected measure to ameliorate one or another of the nuisances shortly touched upon here.

The most that can be said of the work accomplished, is that all the very worst spots have been cleared out or are waiting for the expiration of demolition notices.

All premises in Districts 1, 2, and 3 have been inspected at least once.

Hundreds of windows and ventilating openings have been cut into rooms which were badly ventilated and lighted, or which formerly had neither ventilation nor lighting.

Floors of living rooms, stores and outhouse have been rat-proofed.

Compounds have been drained as thoroughly as possible.

Latrines, and wash-places have been cemented and drained.

Insanitary latrines, wash-houses, small stores, hen-houses and fishcuring rooms, kitchens, etc., to the numbers of 117 have been pulled down without notice.

There are numbers of rooms, however, still requiring whitewashing and cleaning.

Improvement has been somewhat slow, as carpenters and masons have not been present in sufficient numbers to put all the work in hand.

(Sgd.) W. M. HOWELLS,
M.O.

APPENDIX 10.

From the date of the completion of the main report (4th October, 1924), to the present date (31st March, 1925), fifteen cases of plague have been reported, the diagnosis in four of which is doubtful.

2. This makes a total of seventeen cases since the 17th of September, 1924, and a grand total since the 17th of June, 1924, of 157 cases with 136 deaths or a case mortality of 86.6%.

When the nine fatal cases that were recognised between the 1st of April and the 9th of May, 1924, are taken into consideration the grand total for the whole year will be seen to be 166 cases with 145 deaths or a case mortality of 87.3%.

3. The cases occurring between the 17th of September, 1924, and the 31st of March, 1925, were distributed as follows:—

- (a) Kejetia and Kumasi Old Town—four.
- (b) Collections of huts near Bantama—three.
- (c) Outskirts of Asukwa, 3½ miles S.S.W. of Kumasi—two.
- (d) Fanti New Town—two.
- (e) Police Barracks—two.
- (f) Zongo—two.
- (g) Weku, 25 miles N.N.E. of Kumasi, possibly infected in Kejetia—one.
- (h) Zongo Extension—one.

4. The group of the cases reported from Kejetia and Kumasi Old Town was responsible for the town being declared infected from the 15th to the 25th of November, 1924, by Order by the Governor No. 8 of 1924, dated 15th of November, 1924, revoked by Order No. 9 of 1924, dated 25th of November, 1924.

During this period full quarantine conditions were resumed and no one was permitted to leave the area by train, by lorry or on foot unless he was in possession of a pass in the form of a certificate of anti-plague vaccination dated not more than three months previously.

5. Both sexes were represented among the seventeen cases but in the proportion of thirteen males to four females.

6. Ages varied from one month—the diagnosis in this case being somewhat doubtful—to fifty years.

7. Occupations were as follows:—

Labourers seven, traders two, kenkey seller one, fish seller one, mason one, farmer one, motor driver one, infants three.

8. The case mortality amounted to 88.2% if the four doubtful cases are taken into consideration.

Excluding these the case mortality amounted to 84.6%.

9. The vaccinal condition was definite in three fatal and one non-fatal case. All had been vaccinated within seven months of contracting the disease. In this connection it should be remembered that the period during which vaccination confers partial immunity rarely exceeds six months.

Information regarding vaccination in the remaining cases was unreliable.

10. Clinical types were as follows:—

Bubonic four, pneumonic ten, septicæmic three.

11. The last case occurred on the 3rd of March, 1925.

12. No lessening of effort has been allowed as regards anti-plague measures including disinfections, intensive anti-rat campaign, rat-proofing of stores and dwellings, general improvement of housing and general sanitary conditions and anti-plague vaccinations and revaccinations.



An important water supply of Kumasi in June, 1924.



The same rendered less liable to fouling in August 1924.



Interior of a compound in New Zongo. Note (1) Louvred windows, (2) Communal Kitchen, (3) Rat-proof food store in which all corn, ghari, flour, etc. is kept. Already over 800 persons dispossessed from insanitary houses in congested districts of old Zongo have moved into model houses in New Zongo.



View of portion of site in New Zongo reserved for (1) Latrines (one in foreground), (2) Rat- and fly-proof dustbins, (3) Wash houses. Note. Red star and crescent on latrine and white star, etc. on wash house denotes buildings reserved for females. (Inhabitants of New Zongo are of Mohammedan faith.)

13. During the year 1924-25 a total of 165,493 anti-plague vaccinations were carried out in Kumasi and district of which over 163,000 were performed between the 17th of June, 1924, and the 31st of March, 1925.

14. Further, during the same period 11,650 rats were captured.

Of these 291 were suspected as being plague-infected and five were proved conclusively by cultural and biological tests to be infected with the bacillus pestis.

15. Compounds to the number of 223 which could not be rendered sanitary were demolished and accommodation was found for some 1,200 of the dispossessed in 432 rat-proof concrete rooms built in connection with the New Zongo Housing Scheme.

16. An additional important anti-plague measure was carried out when the first portion of the New Market was opened on the 9th of March, 1925.

Some 1,614 vendors were allocated stalls or portions of stalls in the nine completed sheds. This permitted of the transference of that number of vendors of food-stuffs from the old, congested and insanitary market in the centre of Kumasi Old Town to the new commodious and easily cleaned New Market. When the New Market has been completed the remainder of the vendors of cloths and leather goods will be transferred from the Old Market which will then cease to exist other than as an open space.

17. Since the completion of the main report fourteen additional incinerators and 20 fly-proof and rat-proof dustbins have been constructed in areas in which these structures were previously lacking. Destructible refuse is now comparatively easily dealt with and two covered motor lorries are employed in removing indestructible refuse, tins and bottles to a ravine situated outside the town.

18. Similarly, the public latrine accommodation has been very considerably increased so that one pan serves about 25 persons instead of over fifty persons.

The present accommodation is now made up as follows:—

	<i>Seats.</i>
39 temporary modified Salga type latrines erected in 1924-25 ..	308
20 concrete block latrines erected in 1924-25	200
34 concrete block latrines erected prior to 1924-25	494
Total	<u>1,002</u>

The pan latrines are now expeditiously removed with the aid of a fleet of four zinc lined and covered motor lorries which convey nightsoil to the nightsoil disposal area situated a short distance from the town.

P. S. SELWYN-CLARKE,
Senior Sanitary Officer.

31st March, 1925.



Notes on the map:
The map shows the layout of the town of Kumasi, Ghana, and its surrounding areas. The map is a technical drawing of the town's layout, showing the positions of buildings, streets, and other features. The map is a technical drawing of the town's layout, showing the positions of buildings, streets, and other features. The map is a technical drawing of the town's layout, showing the positions of buildings, streets, and other features.

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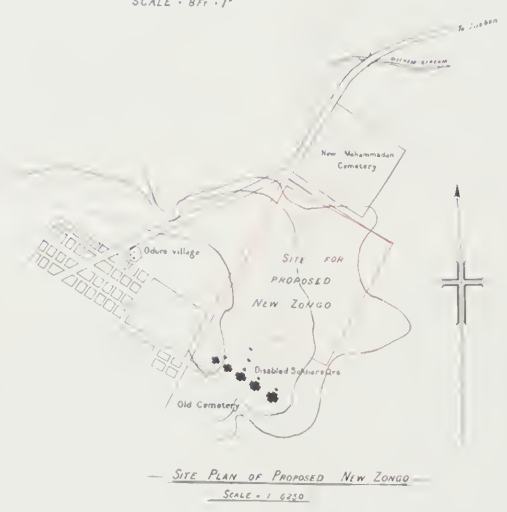
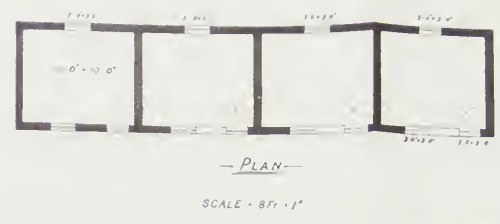
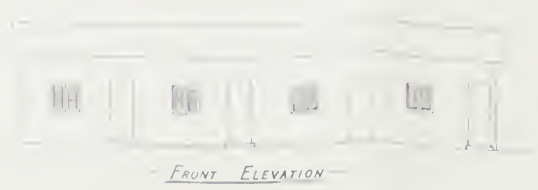
KUMASI - C. D. HOSPITAL

Scale 20. 1 in. = 100 ft.



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LAY OUT NEW ZONGO KUMASI



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